PreCERCLA SCREENING ASSESSMENT

Shelby Industries
SHELBY COUNTY, KENTUCKY
AI# 39894
MARS# Q615
EPA ID: N/A

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US ENVIRONMENTAL PROTECTION AGENCY
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1.0 Introduction

Under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), the Kentucky Department for Environmental Protection (KDEP) conducted a Pre-CERCLA Screening (PCS) at Shelby Industries, 175 McDaniel Road, Shelbyville, Shelby County, Kentucky (the site). This assessment was conducted using the *Hazard Ranking System* (HRS) evaluation tool as well as the documents titled *Pre-CERCLA Screening Guidance,* U.S. Environmental Protection Agency (EPA), Office of Land and Emergency Management, December 2016, and *Guidance for Performing Preliminary Assessments under CERCLA,* EPA, September 1991, as guides for this PCS (Refs. 1-3).

The scope of this PCS included a review of available file documentation, data, on-site reconnaissance and existing targets and pathways.

2.0 Site Description, Operational History, and Waste Characteristics

2.1 Site Location

The site is located at 175 McDaniels Road, Shelbyville, Shelby County, Kentucky (App. A, Fig. 1).

Table 1 represents the GPS information and reference points obtained for the site (App. A, Fig. 1):

Table 1: Shelby Industries Shelbyville, Kentucky Site Coordinates	
Latitude	38.20500400˚
Longitude	-85.25772500˚
Reference Point	Property Entrance (general)
Source Map Scale	Not Applicable
GPS Type	APP
Accuracy (meters)	Not applicable
Collection Method	Google Maps
Reference Datum	NAD83
Collection Date	4/6/2017

2.2 Site Setting and Description

The site is approximately 22.25 acres in size and consists of the facility/warehouse, loading dock/parking lot, and a small tool shed building. An aerial photograph of the site with the property boundary delineated was obtained from the Shelby County Property Value Administrator's (PVA) office (Parcel Number 041-00-016) and a deed was obtained from the Shelby County Clerk's office (Deed Book D361, p. 181 – 184) (App. A; App. B; Ref. 4 and Ref. 5). Waste sites on the property include the pond to the east of the facility warehouse/factory, lagoons on the north side of the warehouse/factory, small capped areas northwest of the warehouse/factory, and inside the warehouse/factory as result of the plating processes that have taken place at the site (App. B; Ref. 6). The site is currently surrounded by industrial and storage properties and can be accessed from the south by McDaniels Road which leads north from Pearce Industrial Road. The site is currently closed to traffic with a gate which is closed during non-business hours (Ref. 6; App. B). The site slopes gently to the north, leading to a steep drop off where an active railroad is present. Topographically any flow from the western portion of the site would flow north to the railroad tracks and then west along the railroad to enter Dry Run Creek and any runoff on the eastern portion of the site would flow north to the railroad, then along the railroad until reaching an unnamed tributary of Clear Creek. The property is currently having hazardous waste and equipment removed while also functioning as a storage and distribution center for a packaging company (App. A, Fig. 1; App. B).

The driveways and parking lots are currently covered by asphalt and used by Pegasus Packing, Inc. for parking and loading trucks (Ref. 6).

The City of Shelbyville lies within the humid subtropical climate zone with temperatures ranging from -20°F to 105° F. The monthly mean average temperature ranges from 34.9˚ F in January to 79.3˚ F in July. The annual maximum mean temperature is 67.8˚ F with an annual minimum mean temperature of 48.6° F. The annual precipitation averages 44.91 inches per year with the wettest months occurring in late spring and summer (Ref. 8).

The site lies in the USGS Simpsonville 7.5 Minute Geologic Quadrangle (Ref. 9). The site is situated on Ordovician System deposits of the Grant Lake Limestone. This unit consists of fossiliferous limestone (~75%) with interbedded 0.1 to 0.2 foot thick nodular beds and occasional cross-beds and calcareous shale. The Grant Lake Limestone is approximately 160 feet thick in this part of Kentucky, at least 120 feet of the unit is present beneath the facility. The Grant Lake overlies the Calloway Creek Limestone, a unit consisting of interbedded coarse-grained fossiliferous limestone (80%) and calcareous shale (20%) with minor siltstone. The Calloway Creek tends to have even bedded limestones up to 0.2 feet thick that are separated by thin shales. (Ref. 9).

The Grant Lake and Calloway Creek limestone formations provide gently to moderately rolling uplands away from major streams. They are more highly dissected where shale content increases, and contain small sinkholes, minor underground drainage, and broad flat valleys where limestone predominates. These formations yield 100 to 500 gallons per day to drilled wells in broad valleys and along streams in uplands. They yield more than 500 gallons per day from thick limestone beds in the broad valley bottoms, but almost no water to drilled wells on hillsides or ridgetops. They also yield water to small springs and seeps. A limestone bed 15 feet thick in the lower part of the Grant Lake Limestone can yield as much as 30 gallons per minute to springs. Water is hard and in valley bottoms may contain salt or hydrogen sulfide (Ref. 9 and Ref. 10).

Businesses located north of the railroad tracks on the north side of the property from west to east include: Roll Forming Corporation, KU Storeroom, Shelbyville Asphalt Company, and Ohio Valley Aluminum. East of the Shelby Industries property are vacant fields and agricultural land. South of the property from west to east are Diesel Pro Kentucky, Inc., and Hieb Concrete Products, Inc. National Envelope (Blaze Products) Corporation lies west of Shelby Industries
(App. B; Ref. 6).

Soils at the site are described as Shelbyville silt loam and Lowell-Faywood silt loams. The typical unit in the Shelbyville silt loam complex is made up of loams with two (2) to six (6) percent slopes. The Lowell-Faywood silt loams exhibit a six (6) to twelve (12) percent slope. Both of these soil types are well-drained and more than 80 inches above the water table. (Ref. 11).

2.3 Operational History and Waste Characteristics

2.3.1 Operational History

In 1973 the Scott and Fetzer Company purchased the property and constructed a truck parts and accessories manufacturing facility. The site was then leased by Valley Tow-Rite, a manufacturer of trailer hitches. From 1973 to 1974, no electroplating occurred at the facility. In 1974, Valley Tow-Rite installed a non-cyanide nickel/chromium electroplating line to chrome plate trailer hitches. The property functioned as a non-cyanide chromium electroplating operation from 1974 to 1982 under a company known as Valley Industries. In 1982, Valley Industries stopped the chromium electroplating and at some point Scott and Fetzer leased this portion of their facility to Shelby Industries, which practiced non-cyanide zinc electroplating (Ref. 12 and Ref. 13; App. B). Lalit K. Sarin bought the property from Scott and Fetzer Company on October 22, 1990. LKS Properties, LLC bought the property from Lalit K. Sarin on December 22, 1998. Shelby Industries continued operations at the site until October, 2016. Shelby Industries is bankrupt and the site is in receivership with LKS Properties being the current owner (Ref. 4 and Ref. 6; App. B). Currently, most of the facility building is being leased as a storage and shipping/distribution center for Pegasus Packing, Inc. Pegasus Packing sells styrofoam, plastic, and cardboard packing materials (App. B).

2.3.2 Regulatory History

During the period from 1974 to 1978, settled solids from spent chromium electroplating solution were discharged into three lagoons to the north of the main building. Some waste may have also been discharged to the pond located east of the building. Hazardous waste produced at this site during this time period was nickel/chromium plating waste (F006 – plating-derived hazardous waste). In 1977 the pond onsite was cleaned and some of the residue was used as fill on the west side of the manufacturing building. Waste from the lagoons was also placed on the west side of the manufacturing building at this time. This waste material was covered by a clay cap some time before 1983. A filter press system for the plating-derived waste was installed in 1978 and the plating-derived hazardous waste (F006) was disposed of off-site by ILWD, a certified hazardous waste disposal company. In 1983, an environmental consulting firm, RETECH Associates, Inc., was retained to locate the closed lagoons, determine if waste was present, and assess closure options for the site. RETECH's May 1, 1983 report (Ref. 12) states, but does not provide the original supporting information, that the following information is known concerning the lagoons and pond:

1) Lagoon #1 is visible on a May 10, 1975 aerial photograph by the Kentucky Department of Transportation.
2) Lagoon #2 was constructed during September-November, 1975 based on contractor bills.
3) Lagoon #1 was closed before April 9, 1976 based on an aerial photograph by Park Aerial Surveys, Inc.
4) The pond was cleaned on June 15, 1977 based on contractor bills.
5) Lagoon #2 was closed and Lagoon #3 was constructed in January 1978, based on contractor bills and interviews with plant personnel.
6) Lagoon #3 was cleaned and closed in September, 1978 based on contractor bills.

RETECH's report (Ref. 12) also recounts taking soil borings in the location of the former lagoons and where the residue from the lagoons and pond was capped. These soil samples were analyzed for chromium, cadmium, nickel, and zinc levels as well as leachability. Total cyanide in soil was also analyzed. Additionally, the report uses background sampling results for the soil metals, but does not directly provide the actual background soil levels. Unfortunately, the report does not document the location(s) where background sample(s) were taken. Moreover, the RETECH report does not provide the chains of custody or the original lab analysis of the soils, only the results. The results indicate that no metals are above current RSLs. Moreover, the levels detected for cyanide in the soil are so low as to support the claim that electroplating at the site was accomplished by non-cyanide methods (Ref. 12).

Surface water data was also taken for the May 1, 1983 report by RETECH. No chains of custody or detailed analytical results were provided. Parameters analyzed for were: pH, specific conductance, cadmium, chromium, nickel, and zinc. None of the reported levels of metals in the surface water exceeded currently-used MCLs (Ref. 12).

Further shallow soil sampling and analysis in six locations adjacent to the building was accomplished as part of a "Certification of Closure" Closure plan dated May 31, 1983 (Ref. 12 and Ref. 13). Samples were taken at the surface and at a depth of one (1) foot. The soil sample parameters were cadmium, chromium, and nickel. Neither chains of custody nor detailed lab analyses were provided in the report. The reported results do not indicate any of the metals were present in numbers exceeding current RSLs (Ref. 12).

On June 16, 1983, the Kentucky Division of Waste Management issued a memorandum verifying the closure of Valley Industries as a storage facility and confirming that electroplating operations resulting in electroplating hazardous waste (F006) were no longer occurring at the site. Valley Industries then published and aired public announcements indicating a desire to terminate the interim status of the facility as a hazardous waste facility in Kentucky under KRS 224.081(2) with a comment period of February 17, 1984 through April 2, 1984. No public comment was received and no public hearing was held. Thus, the facility's interim status as a hazardous waste facility was terminated (Ref. 13).

At some point after Valley Industries ceased operations as a hazardous waste electroplating site producing listed electroplating waste (F006), they leased the property to Shelby Industries. Shelby Industries did non-cyanide zinc electroplating from either 1983 or 1984 until October 28, 2016 when operations ceased due to bankruptcy (App. B; Ref. 6). A February 15, 2017 inspection of the site by the Louisville Field Office of the Kentucky Division of Waste Management discovered and documented numerous petroleum spills in equipment bays and the presence of hazardous wastewater derived from electroplating (F006) that had been on the site longer than 90 days. A RCRA notice of violation was issued to both Shelby Industries and LKS Properties (the bankruptcy receivership) by the Louisville Regional Office's Hazardous Waste Inspector for this waste (Ref. 14).

At the time of the April 10, 2017 site visit for the PCS, current conditions were observed and it was noted that cleanup of the oil spills and removal of the hazardous waste ordered by the RCRA notice of violation was continuing (Ref. 6; App. B).

An April 25, 2017 analysis of pit water by Evergreen Environmental in a bay that held equipment that has been recently removed indicated the presence of oil and grease at 42.3 mg/L, well above the MCL of

5.0 mg/L. Analysis of the same pit water for RCRA 8 metals (mercury, arsenic, barium, cadmium, chromium, lead, selenium, and silver) were all below MCLs (Ref. 15).

Therefore, constituents of concern at the site include oil and grease, and electroplating derived hazardous waste (F006). Constituents of the electroplating derived hazardous waste (F006) are likely to include the metals: cadmium, chromium, nickel, and zinc. Cyanide-based electroplating was never documented at the facility, so cyanide is not a constituent of concern (Refs. 6, 12, 13, 14, and 15; App. B).

2.3.3 Waste Characteristics

Potential hazardous wastes at the site include plating waste (F006) associated with the non-cyanide nickel, chromium, and zinc plating performed at the site. Metals associated with these plating activities include nickel, chromium, cadmium, and zinc. The machinery associated with the plating process also potentially released PAHs, oil, and grease.

Waste sites on the property include the pond to the east of the facility warehouse/factory, lagoons on the north side of the warehouse/factory, small capped areas northwest of the warehouse/factory, and inside the warehouse/factory as result of the plating processes that have taken place at the site (Ref. 6; App. B). The site is currently surrounded by industrial and storage properties and can be accessed from the south by McDaniels Road which leads north from Pearce Industrial Road. The site is currently closed to traffic with a gate which is closed during non-business hours (Ref. 6; App. B). The site slopes gently to the north, leading to a steep drop off where an active railroad is present. Topographically any flow from the western portion of the site would flow north to the railroad tracks and then west along the railroad to enter Dry Run Creek and any runoff on the eastern portion of the site would flow north to the railroad, then along the railroad until reaching an unnamed tributary of Clear Creek. The property is currently having equipment and hazardous waste, as per a RCRA Notice of Violation, removed while also functioning as a storage and distribution center for a packaging company (App. B; App. A, Fig. 1).

3.0 Groundwater Migration Pathway

3.1 Groundwater Migration Targets

The site is situated on Ordovician System deposits of the Grant Lake Limestone. This unit consists of fossiliferous limestone (~75%) with interbedded 0.1 to 0.2 foot thick nodular beds and occasional cross-beds and calcareous shale. The Grant Lake Limestone is approximately 160 feet thick in this part of Kentucky, at least 120 feet of the unit is present beneath the facility. The Grant Lake overlies the Calloway Creek Limestone, a unit consisting of interbedded coarse-grained fossiliferous limestone (80%) and calcareous shale (20%) with minor siltstone. The Calloway Creek tends to have even bedded limestones up to 0.2 feet thick that are separated by thin shales. (Ref. 9 and 10).

The Grant Lake and Calloway Creek limestone formations provide gently to moderately rolling uplands away from major streams. They are more highly dissected where shale content increases, and contain small sinkholes, minor underground drainage, and broad flat valleys where limestone predominates. These formations yield 100 to 500 gallons per day to drilled wells in broad valleys and along streams in uplands. They yield more than 500 gallons per day from thick limestone beds in the broad valley bottoms, but almost no water to drilled wells on hillsides or ridgetops. They also yield water to small springs and seeps. A limestone bed 15 feet thick in the lower part of the Grant Lake Limestone can yield as much as 30 gallons per minute to springs. Water is hard and in valley bottoms may contain salt or hydrogen sulfide (Ref. 10).

Drinking water to the area is supplied by the West Shelby Water District (Ref. 16). The West Shelby Water District obtains water from two (2) sources: 1) Shelbyville Municipal water, which obtains surface water from Guist Creek Lake, located five (5) miles east of Shelbyville, and 2) Louisville Water, which obtains water from 2 (two) water treatment plants located at Ohio River water intakes in Jefferson County (Ref. 16).

There are no domestic or agriculture use wells within a four (4) mile radius of the site (App. A, Figure 2). One (1) inactive spring (Harrington Mills Pike Spring) is classified as having “other” (potential agricultural/livestock use) use by the Kentucky Division of Water lies within the two to three (2-3) mile radius (App. A, Fig. 2). The inactive Harrington Mills Pike Spring flows into a spring house and then enters a farm pond (App. A, Figure 2). The Harrington Mills Pike Spring is topographically and stratigraphically higher than the site (Ref. 9). Well and Spring Inventories are listed in Tables 2 and 3 below:

Table 2:
Well Inventory (based upon App. A, Figure 2)

Distance	Well #	Estimated Population Served	Type
0 – ¼	0	0	N/A
¼ - ½	0	0	N/A
½ - 1	0	0	N/A
1 – 2	0	0	N/A
2 - 3	0	0	N/A
3 - 4	0	0	N/A

*Average Household size is 2.52 (Ref. 7)

Table 3:
Spring Inventory (based upon App. A, Figure 2)

Distance	Spring #	Estimated Population Served	Type
0 – ¼	0	0	N/A
¼ - ½	0	0	N/A
½ - 1	0	0	N/A
1 – 2	0	0	N/A
2 - 3	1	0	Inactive – Potential Agricultural/Livestock Use
3 - 4	0	0	N/A

*Average Household size is 2.52 (Ref. 7)

3.2 Groundwater Migration Pathway Conclusions

A release from this site has a very low potential to impact the groundwater at this site. Only one inactive spring classified as having “other” (potential agricultural/livestock use) by the Kentucky Division of Water is in the four (4) mile radius distance (App. A, Figure 2). This represents no potential targets. Municipal supplied drinking water is available to all residents in this area of Shelby County (Ref. 16). KDEP does not consider the Groundwater Migration Pathway a concern due to the lack of groundwater users.

4.0 Surface Water Migration Pathway

4.1 Overland Flow Route

The site is currently a commercial property with one (1) large manufacturing/warehouse building and one (1) small building used for grounds keeping equipment. The manufacturing/warehouse building is built on slab. The driveways and parking infrastructure are currently covered with blacktop (App. B).

The dominant surface water system for the area is Clear Creek. Surface water flows north across the site via sheet flow to a ditch adjacent to a railroad. Surface water on the west side of the property enters the railroad ditch and continues west to Dry Run Creek, where it flows south for two (2) miles to enter Clear Creek. Surface water on the east side of the property enters the railroad ditch and flows east to an unnamed tributary of Clear Creek. Clear Creek enters Brashears Creek and eventually enters the Salt River (App. A, Fig. 3, Fig. 4). The site does not lie within the 100 or 500 year flood plain (App. A, Fig. 3).

The annual precipitation averages 44.91 inches per year with the wettest months occurring in late spring and summer (Ref. 8). The 2-year, 24-hour rainfall frequency for Shelby County is three and seven-tenths (3.7) inches (Ref. 8). The site does not lie within the 100 or 500 year floodplain (App. A, Fig. 3).

The Overland Flow Route is the migration route that runoff would follow from a particular onsite source into a perennial surface water body (Refs. 1-3). Furthermore, any point at which site run-off enters a perennial surface water body is considered a Probable Point of Entry (PPE).

As shown in the site photos (App. B) and the site map (App. A, Fig. 1; Ref. 9) the run-off from the site flows gently north via sheet flow. The surface water run-off flows to the railroad cut on the northern boundary of the site. Runoff from the eastern portion of the property enters the railroad cut and flows west 1351 feet to a PPE located at the head of an unnamed tributary of Clear Creek. Runoff on the western portion of the property enters the railroad cut and flows west 1309 feet to a second PPE located on Dry Run Creek (App. A, Fig. 3, Fig. 4).

4.2 Target Distance Limit

The Surface Water Target Distance Limit (TDL) is the migration route that site generated run-off would follow from the point it enters a perennial surface water body (PPE) to a point 15 miles downstream of the PPE (Refs. 1, 2). Flow from the second PPE in Dry Run Creek enters Clear Creek approximately two (2) miles south of the site. The 15 mile TDL is completed within Clear Creek (App. A, Fig. 3).

4.3 Surface Water Migration Pathway Targets

There are no surface water intakes within the 15 mile TDL (App. A, Fig. 3). Drinking water is supplied by the West Shelby Water District. The surface water intake for the West Shelby Water District is Guist Lake, which is located approximately five (5) miles east of Shelbyville (Ref. 16). The West Shelby Water District sometimes buys water from Louisville Water, which withdraws water from two sites on the Ohio River (Ref. 16). Neither source is expected to be affected by the site.

No direct evidence of fishing was observed during site reconnaissance, however, Clear Creek has a listing on the Kentucky Department of Fish and Wildlife fishing guides; it is likely that some recreational fishing occurs on Clear Creek (Ref. 17).

There are approximately 29.86 miles of Riverine wetlands along the 15 mile TDL. There are approximately fourteen hundredths (0.14) total miles of Freshwater Forested wetlands along the 15 mile TDL. The Riverine wetlands always have water flowing (App. A, Fig. 3; Ref. 18, p. 15). The Freshwater Forested wetland is a short, seven hundredths of a mile long (0.07), area near the terminus of the TDL and is dominated by trees that reach at least 20 feet in height (App. A, Fig. 3; Ref. 18, p. 35).

There are federally and state listed endangered or threatened species in Shelby County. Table 4 lists these species and their status (Ref. 19):

Table 4:
Endangered and Threatened Species

Scientific Name	Common Name	Class	US Status	State Status
Actitis macularius	Spotted Sandpiper	Aves	N	E
Amphiuma tridactylum	Three-toed Amphiuma	Amphibia	N	E
Anas clypeata	Northern Shoveler	Aves	N	E
Anas discors	Blue-winged Teal	Aves	N	E
Asio flammeus	Short-eared Owl	Aves	N	E
Asio otus	Long-eared Owl	Aves	N	E
Chondestes grammacus	Lark Sparrow	Aves	N	T
Fulica americana	American Coot	Aves	N	E
Haliaeetus leucocephalus	Bald Eagle	Aves	N	T
Myotis grisescens	Gray Myotis	Mammalia	E	T
Myotis sodalis	Indiana Bat	Mammalia	E	E
Phalacrocorax auritus	Double-crested Cormorant	Aves	N	T
Podilymbus podiceps	Pied-billed Grebe	Aves	N	E
Toxolasma lividum	Purple Lilliput	Bivalvia	N	E

Federal Status Definitions: E= Endangered, T= Threatened, N= No Federal Status
State Status: E= Endangered, T= Threatened, S= Special Concern

No surface water intakes are located within the 15 mile TDL. The nearest wetland of concern is near the terminus of the TDL (Refs. 1-3; App. A, Fig. 3).

4.4 Surface Water Migration Pathway Conclusions

KDEP does not consider the Surface Water Migration Pathway to be a concern.

5.0 Air Exposure Pathway

The Air Migration Pathway was not evaluated because there are no active emissions (App. B).

6.0 Soil Exposure Pathway

6.1 Soil Exposure Pathway Targets

The site is currently a large building and a small equipment shed. The paved driveway and parking lot covers a large portion of the property. The large building is built slab on grade. The driveways and parking infrastructure are currently covered with asphalt. A small man-made farm pond exists due east of the large building. The southeastern portion of the building is planted with conifers as part of a Christmas tree farm (App. B; Ref. 6).

The original area of concern were small lagoons located on the north side of the main building and an area where waste from these lagoons was buried on the west side of the main building (Ref. 12). This area contained wastes derived from non-cyanide nickel and chromium plating. These wastes may have been removed from the site because of the closure letter granted (Ref. 13), but no records exist of the final disposition of this waste.

Evidence of non-cyanide zinc electroplating hazardous waste (F006) and oil and grease were observed during the PCS site visit (App. B; Ref. 6).

No (0) residences lie within 200 feet of the site boundary; access is limited by a gate on McDaniel Road, and a fence on all sides (App. A, Fig. 1; App B; Ref. 6). This area of Shelbyville has been experiencing tremendous growth since the 1980s when much of the original site activity occurred. Approximately 2,369 people live within one (1) mile of the site; this is significantly higher than the 1,726 people who lived in the area when the 2000 census was taken (Ref. 7).

Access to the site is via McDaniel Road. Access is currently limited to the remediation of left over hazardous waste at the site and the current use of the site a storage and distribution system for Pegasus Products (App. B; Ref. 6).

No sensitive populations are within 200 feet of the site. The site does not pose an attractive nuisance to local residents as access is limited by fencing and a gate (App. B; Ref. 6).

6.2 Soil Exposure Pathway Conclusions

Due to lack of targets and small source area, KDEP does not consider the Soil Exposure Pathway a concern.

7.0 Summary and Conclusions

The site was initially a non-cyanide nickel and chromium plating facility that eventually switched to performing only non-cyanide zinc plating. During the late 1970s and early 1980s, plating waste was put in the pond and in three small lagoons at the site. This waste was removed from the pond and lagoons and placed into an area west of the main building in 1983 (Ref. 12 and Ref. 13). This waste may have been removed from the site, but records are incomplete. From 1983 to October, 2016 non-cyanide zinc electroplating was done on the site (Ref. 6).

The site is currently being used as a distribution center for a packing materials supply company. The non-cyanide zinc electroplating operations ceased in October, 2016. There is some hazardous plating waste and oil and grease that has been on the site for more than 90 days. This hazardous waste is currently being removed under the order of the Louisville Regional Office. The remaining portion of the site is mostly parking, open fields, and a Christmas tree farm. Access to the site is limited by fencing and a security gate which is open only when the distribution company's activities are occurring (App. B; Ref. 6).

There is no (0) active domestic use spring within the four (4) mile radius of the site (App. A, Fig. 2). However, there is one non-active agricultural spring within the four (4) mile radius (App. A, Fig. 2). KDEP does not consider the Groundwater Migration Pathway a concern due to a low number of targets. The residents of the area are supplied with drinking water from a surface water source that is outside the local drainage basin that is not impacted by the site (App. A, Fig. 2; Refs. 16).

The Soil Exposure Pathway was evaluated, but was determined to not be a concern. There are no (0) residences on the site and no (0) residences are within 200 feet of the site (App. A, Figure 1; App. B; Ref. 6). Site access is limited by fencing and a security gate (App. B; Ref. 6). KDEP does not consider the soil exposure pathway to be a concern due to the limited number of targets.

The Air Migration Pathway was not evaluated because there are no active emissions (Ref. 6).

The Surface Water Migration Pathway was evaluated and determined not to be a concern due to the distance of the site to environmentally sensitive features and lack of surface water targets. There are 29.86 miles of Riverine wetlands along the 15 mile TDL. There are approximately fourteen hundredths (0.14) total miles of Freshwater Forested wetlands along the 15 mile TDL. The Freshwater Forested wetland is a short, seven hundredths of a mile long (0.07), area near the terminus of the TDL and is dominated by trees at least 20 feet in height (App. A, Fig. 3; Ref. 18, p. 35).There are no surface water intakes in the 15 mile TDL (App. A, Figure 3).

There are insufficient targets to warrant further action at the site, therefore, KDEP does not recommend further action under CERCLA.

8.0 References

1. Federal Register, 40CFR Chapter 1 Subchapter J Part 300 Subpart L-Appendix A. Hazard Ranking System, Final Rule, 14 December, 1990.

2. U.S. Environmental Protection Agency, Hazardous Site Evaluation Division, Publication EPA/540/G-91/013, Titled: *Guidance for Performing Preliminary Assessments Under CERCLA*, September 1991.

3. U.S. Environmental Protection Agency*, Office of Land and Emergency Management*, Titled *Pre-CERLCA Screening Guidance*, December 2016.

4. Site Deed (Deed Book D361, p. 181 – 184). Obtained from Shelby County Clerk's Office.

5. Site Map obtained from Shelby County PVA.

6. Site Investigation Report. Site visit on 4/6/17.

7. Missouri Census Data Center, Circular Area Profiling System, Online: http://mcdc.missouri.edu, Accessed May 3, 2017.

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11. U.S. Department of Agriculture and Soil Conservation Service, *Custom Soil Resource Report for Shelby County, Kentucky, Online: http://websoilsurvey.nrcs.usda.gov/app/*, Accessed May 5, 2017.

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14. McAleer, Lynn, February, 2017, Inspection and NOV. KDEP Files. 8 p.

15. McAleer, Lynn, May 3, 2017, Email with analytical report.

16. West Shelby Water District, http://westshelbywater.org/, Accessed April 13, 2017.

17. Kentucky Department of Fish and Wildlife Resources, Fishing on Clear Creek, https//app.fw.ky.gov/fisheries/waterbodydetail.aspx?wid=140, accessed May 9, 2017.

18. Adapted from Cowardin, Carter, Golet, and LaRoe, 1979, *Classification of Wetlands and Deepwater Habitats of the United States,* August 2013, 2nd edition. 90 p.

19. Kentucky, Department of Fish and Wildlife and Resources, Species Information, Online: http://app.fw.ky.gov/speciesinfo/countyListSpecies.asp. Accessed May 5, 2017.

Appendix A

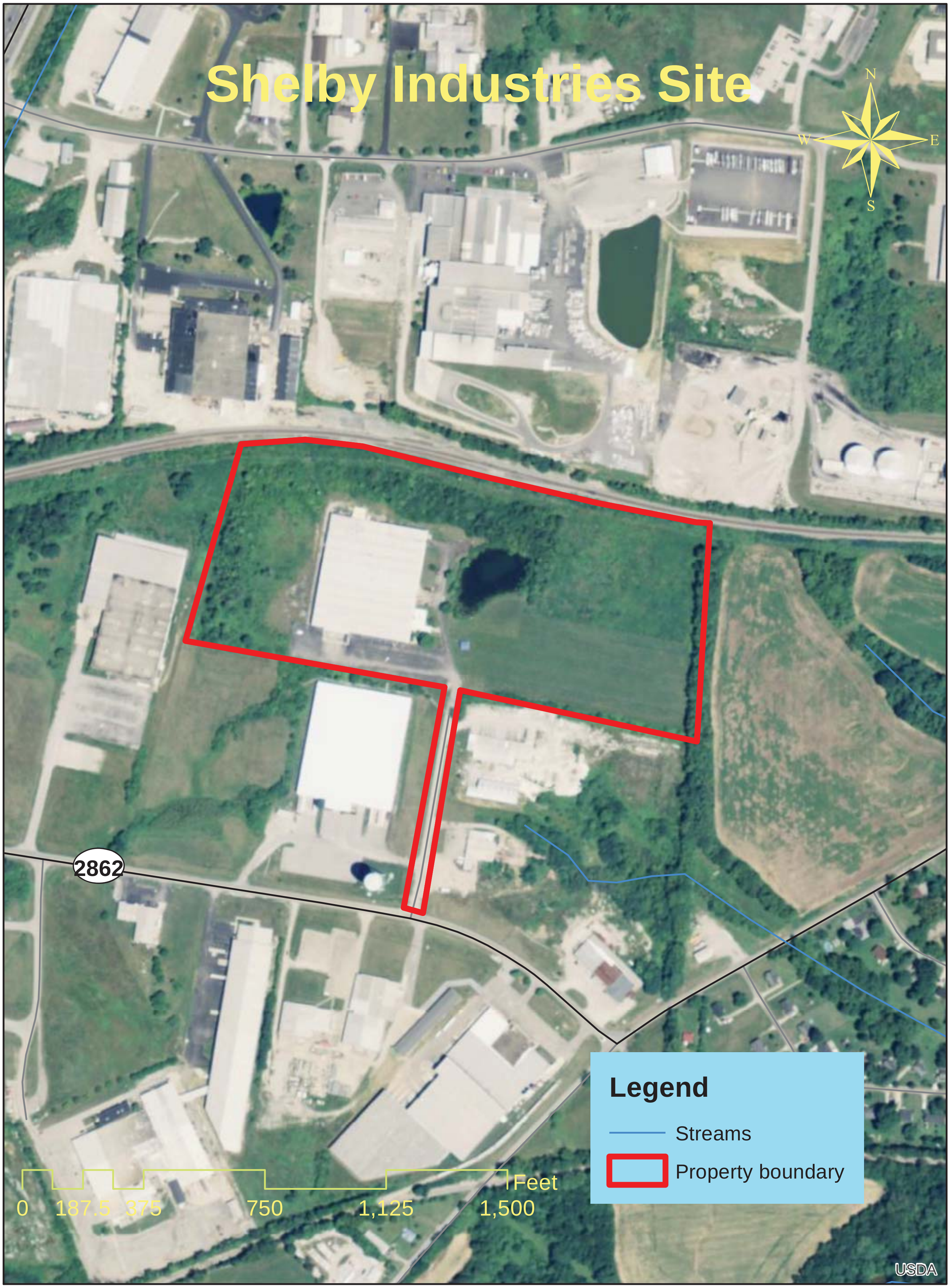
A1 - Site Location Aerial

A2 - One Quarter, One Half, One, Two, Three, and Four Mile Radius Map

A3 - Surface Water 15 mile showing PPE and Wetlands

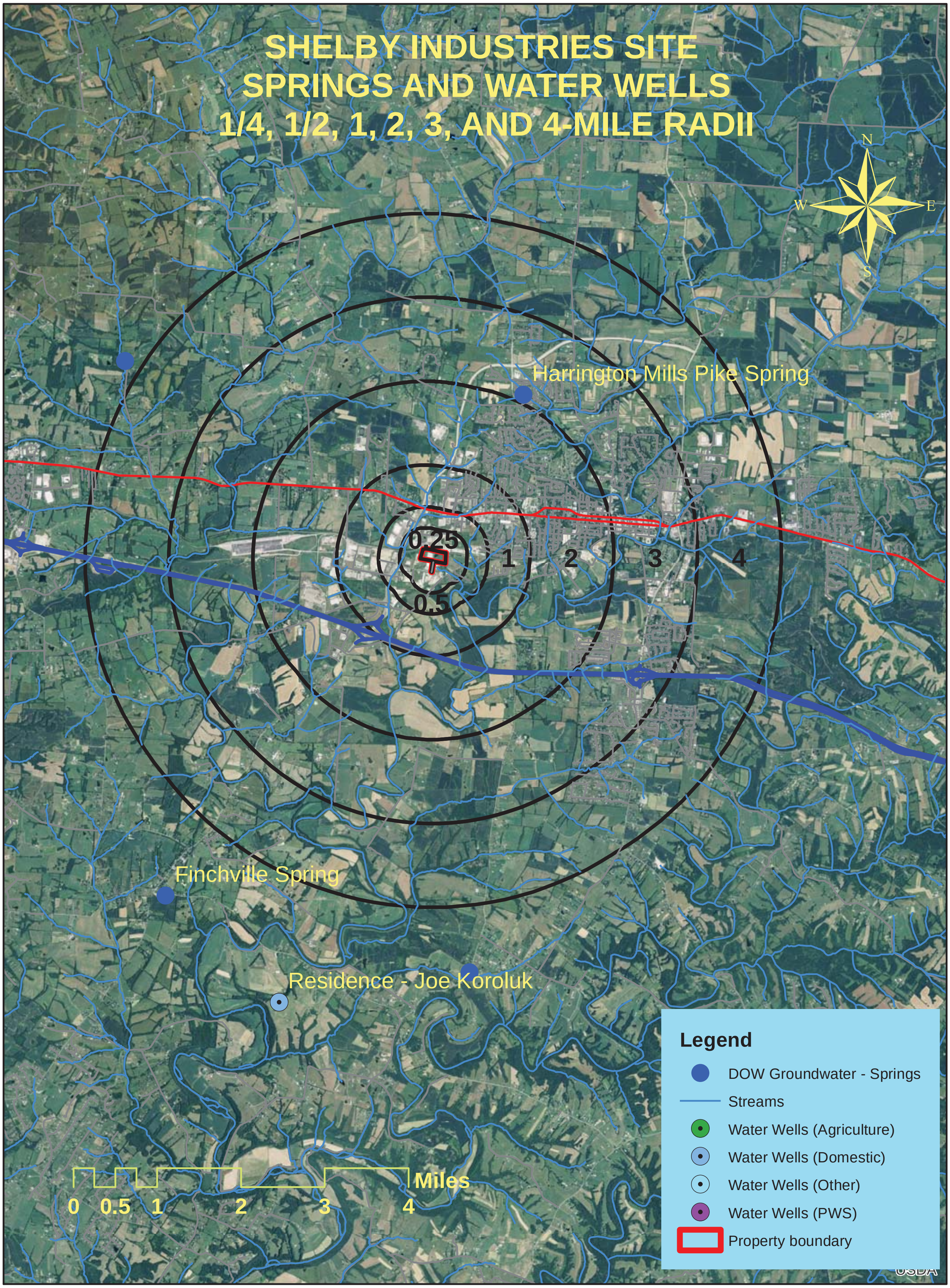
A4 – Direction of Sheet Flow

Figure A1. Site location aerial and approximate boundaries.



Shelby Industries Site
PCS, May 2017

Figure A2. 1/4, 1/2, 1, 2, 3, and 4-miles radius map showing springs and groundwater wells..



Shelby Industries Site
PCS, May 2017

Figure A3. Surface water 15 miles downgradient showing Probable Points of Entry, DOW permitted water withdrawls, and wetlands.

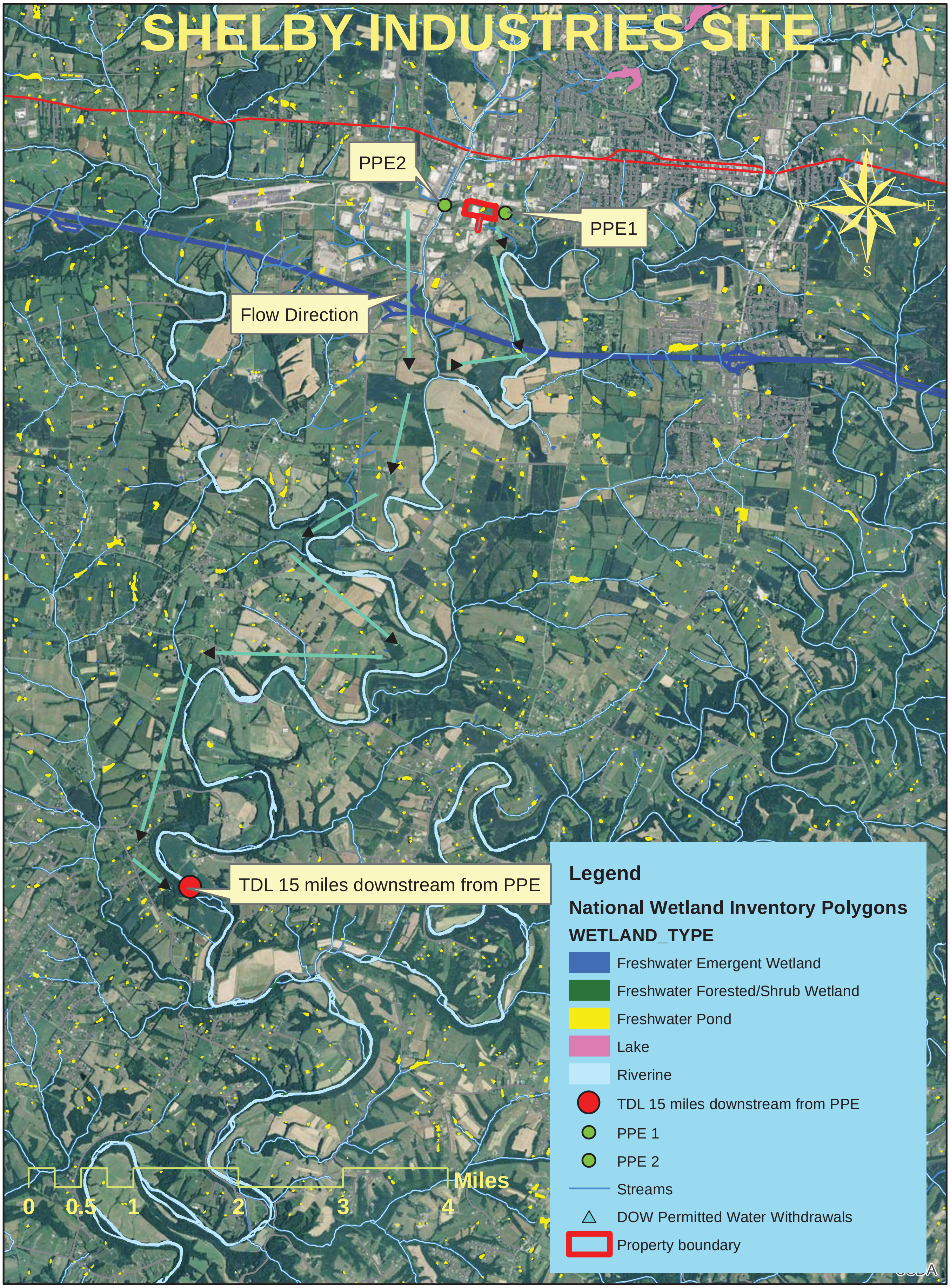
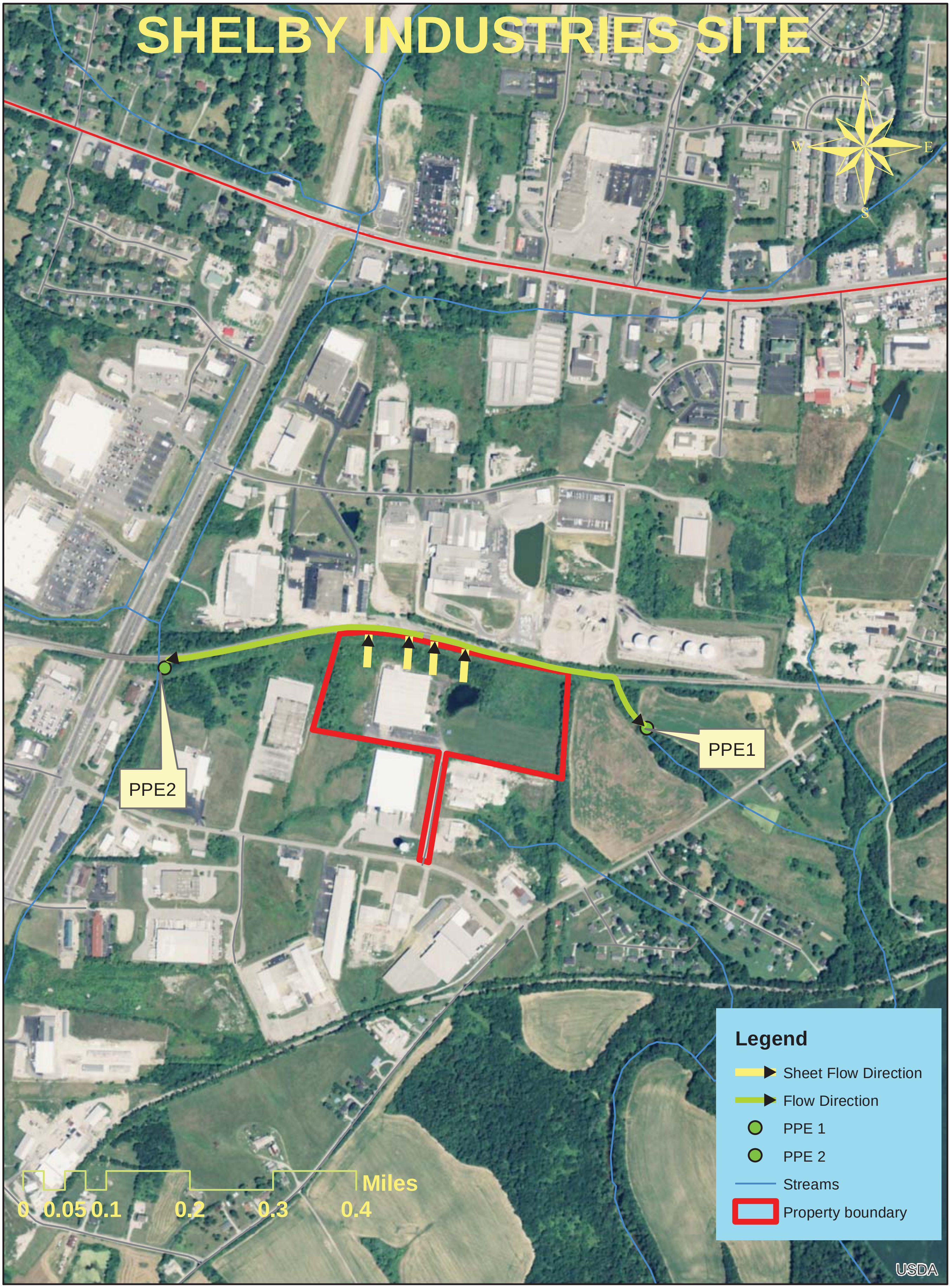


Figure A4. Sheet Flow from the Site to PPEs.



Shelby Industries Site
PSC, May 2017

Appendix B

Site Visit Report

Photos from Site Visit Report

Deed

PVA Map

Energy and Environmental Protection Cabinet
Department for Environmental Protection
Division of Waste Management

Site Inspection Report

Site/Permit ID: **39894 Mars Q615**			Regional Office: **Louisville**
Site Name: Shelby Industries			Program: Superfund
Site Address: 175 McDaniel Road, Shelbyville KY 40065			
City: Shelbyville	State: Kentucky	Zip: 400065	County: Shelby
Site Contact: Mr. William Yeager		Title: LKS Property Manager	Phone #: 502-718-3796
Inspection Type: Non-comprehensive	Purpose: Site Visit for Pre-CERCLA Screening		Not/Com #:
Inspection Dates: 4/6/17	Time: 10:30 am to 12:30 pm		
Latitude: 38.20500400	Longitude: -85.25772500		
Coordinate Collection Method: GPS +/- 90 Meters			
Type of Site: **Pre-CERCLA Screening (PCS) under PASI**			

I. Investigation Results

Findings/Violations/Recommendations:

At 8:45 am Daniel Phelps, PG, of the KY DEP – Superfund Branch arrived at the Louisville Field Office to discuss the recent history of the site and the goals for the Pre-CERCLA Screening (PCS) for the site visit with Ms. Lynn McAleer, an inspector with the Louisville Field Office. Ms. McAleer has been responsible for recent Hazardous Waste inspections at the site which have revealed numerous violations for unlabeled drums of hazardous waste staying on site for more than 90 days.

Phelps and McAleer arrived on the site at approximately 10:30 am EST. It was ~40º F and cloudy with occasional light rain. They met with Mr. William Yeager, an employee of LKS Properties (the current owner 502-718-3796) and Mr. Russell H. Brooks, PG, Senior Engineer, of the consultant Linebach Funkhouser, Inc. (502-895-5009). Mr. Yeager was a long-time employee of Shelby Industries when they operated the facility.

The interior of the warehouse building was observed. Four pits in the concrete where various pieces of equipment had formerly been located in the first large warehouse room on the east side of the building were viewed. These pits were filled in part with a mixture of water and machine oils as well as metal cuttings/filings. These pits are in the process of being remediated by consolidating and removing the pit contents. On the north end of the building there were many recently-labeled containers of hazardous waste. These containers included drums holding mixtures of water and hydrochloric acid, pickle liquor from zinc metal plating and processing, and various oils used in the machinery. Also present were open plastic containers containing similar hazardous waste. According to NOVs filed by Ms. McAleer, LKS properties has until April 24, 2017 to have these wastes properly disposed of or face enforcement action. The equipment making up the zinc plating line with numerous processing tanks was still in place. Supposedly, this plating line equipment will soon be sold and removed or else recycled. Powdered zinc residue, a non-hazardous waste, was observed in the vicinity of a chiller to the zinc plating line. There were also tanks present as part of separator system for waste water treatment. Mr. Yeager stated that Shelby Industries only did zinc plating since sometime before 1983.

Much of the rest of the interior of the building is leased by Pegasus Packing, Inc. Pegasus Packing has large amounts of cardboard, plastic bubble wrap and plastic sheeting, and styrofoam stored at the site. They use the site as a distribution center. Two (2) forklifts were active moving the packing materials to and from trucks for use elsewhere. Fewer than five (5) employees were on site, including Mr. Yeager of LKS Properties.

The areas surrounding the exterior of the building were also observed. A search was made for the three former lagoons described in a 1983 report as lying north of the building. In spite of a search based on the map in the 1983 report, there was no evidence of the lagoons; there were no changes in topography or major differences in vegetation where the maps indicated the lagoons had existed. Some areas had gravel fill, but this did not appear to correlate with the locations of the former lagoons. Further to the north of the building is a fence and heavily vegetated area. This fence, located on the property line, and vegetation separates the property from a steep drop off leading to an active railroad line.

West of the building a search was made for the area in which material removed from the lagoons was supposedly buried and capped. This area was mostly covered with shrubbery and small trees, but there were no noticeable changes in relief or vegetation in the vicinity of where the 1983 map indicated the capped material was located.

The area south of the building is a parking lot for visitors and the western portion of this lot features a loading dock where trucks are currently moving packing supplies.

The area east of the building is dominated by a large pond. The hummocky topography of the land immediately east of the pond suggests that the pond is not natural, but was excavated. Therefore the cattails and other features along the shore of the pond are not natural wetlands. The northeastern most portion of the property is a large open field. The southeastern most portion of the property (approximately 6 acres) has been set up as a Christmas tree farm with several types of pines and firs planted in neat rows.

The immediately surrounding properties are all light industrial and storage businesses that are part of a local industrial park off of Pearce Industrial Road. There are two subdivisions, off Old Finchville Road. One is located on Stuart Drive and the other on Victoria Drive, located less than ¼ mile east southeast of the site.

Businesses located north of the railroad tracks on the north side of the property from west to east include: Roll Forming Corporation, KU Storeroom, Shelbyville Asphalt Company, and Ohio Valley Aluminum. East of the Shelby Industries property are vacant fields and agricultural land. South of the property from west to east are Diesel Pro Kentucky, Inc., and Hieb Concrete Products, Inc. National Envelope (Blaze Products) Corporation lies west of Shelby Industries.

The property was exited after 12:30 pm.

After the site visit, Phelps went to the Shelby County PVA Office where he obtained an aerial photograph showing the parcel of land in question (Parcel Number 041-00-016). Phelps then proceeded to the Shelby County Clerk's office in the same building, where he obtained a copy of the deed for the site (Deed Book D361, Page 181-184).

Compliance Status - Not Applicable

II. Comments Including Remedial Measures and Expected Correction Dates

Comments: Not Applicable

III. Environmental/Human Health Impact

Findings/Violations/Recommendations:

Compliance Status - Not Applicable

IV. Documentation

- ☒ Photos taken by Daniel Phelps, PG
- ☐ Record of visual determination of opacity
- ☐ Documents Obtained From Facility
- ☐ Samples taken by DEP
- ☐ Samples taken by outside source
- ☐ Regional Office instrument readings taken
- ☐ Other documentation
- ☒ Site Hazard Assessment Completed

Comments:

Inspector:	Title:	Date:
Overall Compliance Status		
☐ **No violations observed**		
☐ **No violations observed but impending violation trends observed** – Advisory Action Taken		
☐ **Out of Compliance. Non-recurrent deficiency noted –** Verbal notice given or violation corrected at time of inspection.		
☐ **Out of Compliance. Non-recurrent administrative or O & M deficiency noted –** Warning Notice issued		
☐ **Out of Compliance** – NOV issued		

Received By: Daniel Phelps, PG	Title: Geologist Registered	Date: 4/10/17
Delivery Method:		

Figure 1. Eastern interior of Shelby Industries warehouse looking towards the north.

Figure 2. Pits filled with machine oil, water, and metal shavings on east side of the warehouse. Looking north.

Figure 3. Southernmost pit. Filled with absorbent material so oil and other liquids may be removed.

Figure 4. Second southernmost pit. Filled with oil, water, and metal shavings. Note deep red color of the liquid.

Figure 5. Third southernmost pit. Note oil staining.

Figure 6. Northernmost pit. At least 8 feet deep. Note oil/water and metal staining.

Figure 7. Four pits looking south.

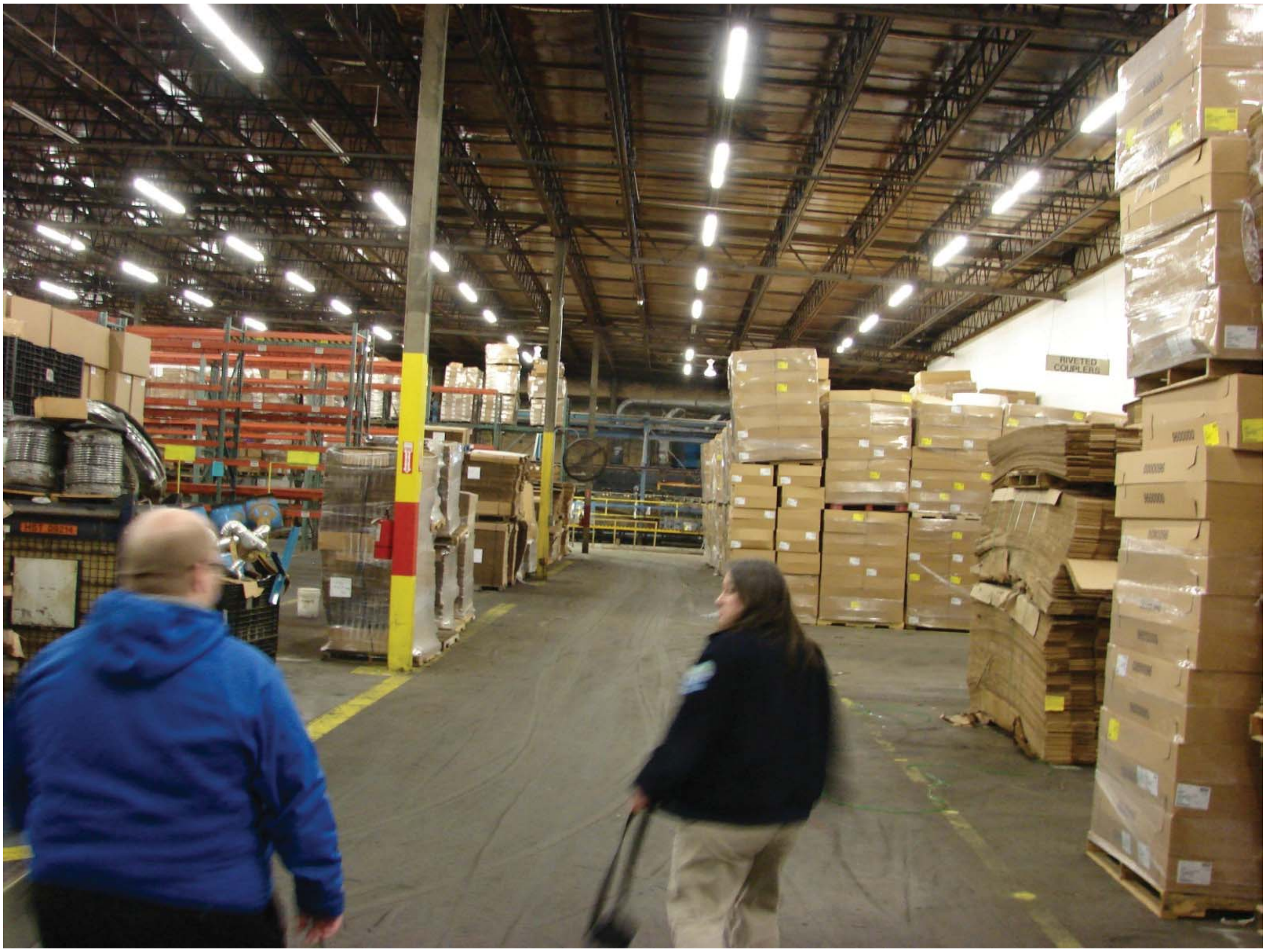


Figure 8. Area being used for storage of packing materials by Pegasus Packing.

Figure 9. Drums of hazardous waste on north side of building.

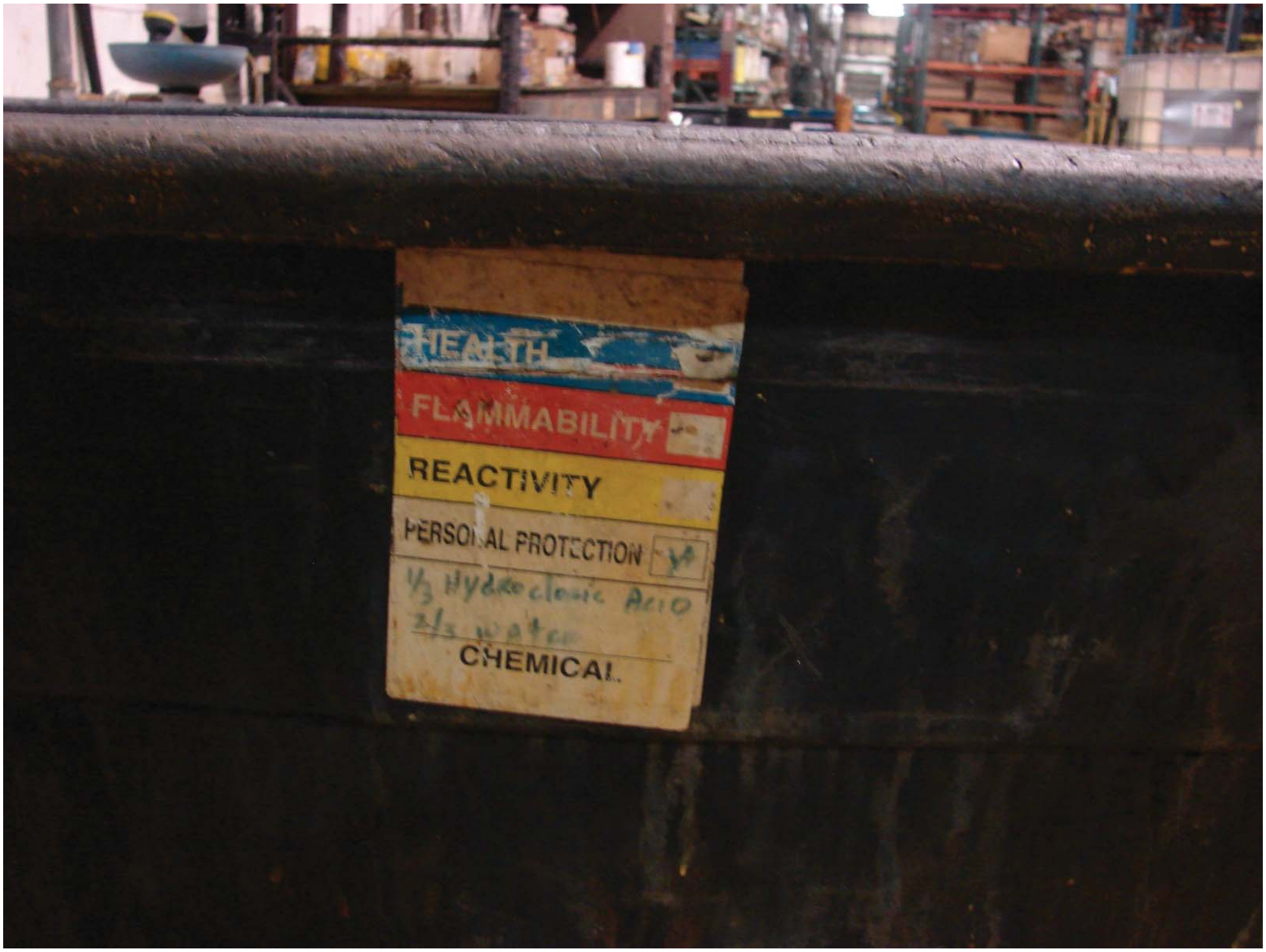


Figure 10. Open drum of 1/3 HCl, 2/3 water.

Figure 11. Equipment and waste drums in smaller room on north side of warehouse.

Figure 12. Zinc plating line next to wall. Hazardous waste drums, some still not properly labeled, in the foreground.

Figure 13. Area north of warehouse where former lagoons were mapped in 1983 report. Surface gravel does not correspond to position or shape of the lagoons.

Figure 14. Area North of warehouse where former lagoons were mapped in 1983 report.

Figure 15. Northern end of warehouse looking west to where capped area was mapped in 1983.

Figure 16. Northeastern corner of the building looking west to where former lagoons were mapped in 1983.

Figure 17. Zinc residue (non-hazardous waste) near chiller tank on north end of the warehouse.

Figure 18. Area west of the warehouse looking to the northeast corner of the building. The capped area mapped in 1983 would be in the vicinity of the northwest corner.

Figure 19. Vegetated area west of the building looking east towards the warehouse.

Figure 20. Vegetated area where capped material was mapped in 1983. No apparent changes in vegetation or topography evident.


Figure 21. Vegetated area west of warehouse.

Figure 22. West side of the warehouse.

Figure 23. Open hazardous waste container in northwestern portion of the warehouse. Probably "pickle liquor" spent/used acid from the zinc plating operation.

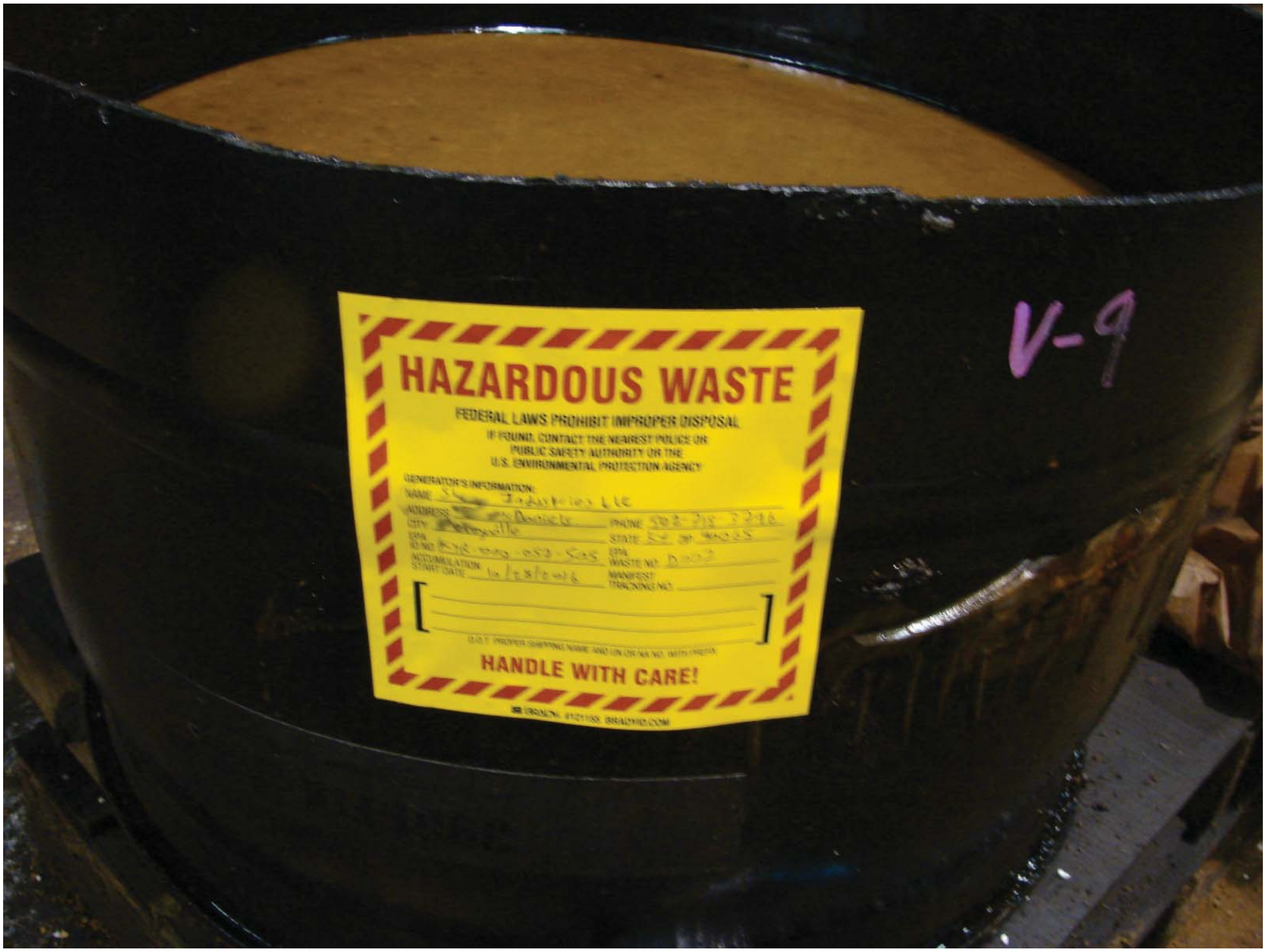


Figure 24. Close-up of open hazardous waste container's label. Probably spent "pickle liquor" D007 used acid from the zinc plating operation.

Figure 25. Zinc plating line looking from south to north. Northwestern portion of the warehouse.

Figure 26. Packing materials stored by Pegasus Packing.

Figure 27. Artificial pond located east of warehouse.

Figure 28. Southeast shore of pond. Note cattails.

Figure 29. East Shore of the pond.


Figure 30. Christmas tree farm on southeastern portion of the property.

Figure 31. View from just south of pond to the south towards the Christmas tree farm.

Figure 32. Parking lot and loading dock on the south side of the building.

GENERAL WARRANTY DEED

THIS DEED is made as of December 22, 1998, between

LALIT K. SARIN
5609 Wolf Pen Trace
Prospect, Kentucky 40059 (the "Grantor")

and

LKS PROPERTIES, LLC,
a Kentucky limited liability company
P.O. Box 308
Shelbyville, Kentucky 40065 (the "Grantee").

WITNESSETH:

For good and valuable consideration, receipt of which is acknowledged by Grantor, Grantor hereby grants and conveys unto the Partners and the Partners grant and convey unto Grantee in fee simple and with covenant of General Warranty the real property located in Shelby County, Kentucky and more fully described as follows:

BEGINNING at an iron pin in the eastern line of the Shelbyville Finishing Co. property, said point being N. 14 degrees 48 minutes E. 670.0 feet from the southeastern corner of the Shelbyville Finishing Co., opposite Station 25 + 20.9 of the Kentucky Highway S.P. 106-456 and running thence with the Finishing Company's line N. 14 degrees 48 minutes E. 627.1 feet to an iron pin in the southern margin of the Southern Railroad Company line; thence with the margin of said Railroad Company along a 1,125 foot radius curve in an easterly direction 399.4 feet to an iron pin; thence continuing with the margin of the Southern Railroad Company property S. 78 degrees 00 minutes E. 1063.2 feet to an iron post; corner to the McBride property; thence with McBride's line S. 2 degrees 10 minutes W. 641.0 feet to an iron pin; thence through the property of the Shelby County Industrial Development Corp., N. 79 degrees 12 minutes W. 1,565.8 feet to the beginning.

Together with all appurtenant rights, privileges and easements thereunto belonging, including, without limitation, the rights reserved by the Scott & Fetzer Company, Grantor's predecessor in interest, in paragraph 2 of section B of that certain deed dated April 18, 1973 between Laban P. Jackson, et al. and Shelby County, Kentucky, which Deed was filed for record in the Office of the County Clerk of Shelby County, Kentucky on April 27, 1973 and was recorded in Deed Book 180, Page 80.

BEING the same property acquired by Grantor by Deed dated October 22, 1990, of the record in Deed Book 266, page 594 in the office of the Clerk of Shelby County, Kentucky.

Grantor covenants lawful seisin of the estate hereby conveyed, full right and power to convey same and that said estate is free of encumbrances except (i) Mortgage of record in Mortgage Book 190, Page 676; (ii) Second Mortgage of record in Mortgage Book 190, Page 696; (iii) a financing statement of record in Mortgage Book 190, Page 708; (iv) financing statement of record in Mortgage Book 190, Page 711; and (v) an Assignment of Rents and Leases of record in Deed Book 248, Page 660 and liens for real property taxes and assessments due and payable in 1999, and thereafter, which the Grantee assumes and agrees to pay; however, this conveyance is made subject to easements, restrictions and stipulations of record and governmental laws and regulations affecting the Property herein conveyed.

To have and to hold the Property together with all of the rights, privileges, appurtenances and improvements thereunto belonging unto the Grantee, and its successors and assigns forever, with covenant of general warranty of title.

Patricia A. Sarin, the wife of Grantor, joins in this Deed solely for the purpose of conveying whatever dower interest she may have in the aforementioned described property.

This conveyance is exempt from transfer tax pursuant to KRS 142.050(7)(k).

Witness the signatures of the Grantor as of the day and year first above written.

GRANTOR:

L.K. Sarin

Lalit K. Sarin

Pat Sarin

Patricia A. Sarin

Consideration Certificate

We, the undersigned, do hereby certify, pursuant to KRS Chapter 382, that the property herein conveyed is transferred for nominal consideration and that the estimated fair cash value of the property herein conveyed is $ 1,174,000 .

GRANTOR:

L.K. Sarin

Lalit K. Sarin

Pat Sarin

Patricia A. Sarin

GRANTEE:

LKS PROPERTIES, LLC
a Kentucky limited liability company

By: L.K. Sarin

Lalit K. Sarin, Member

COMMONWEALTH OF KENTUCKY)
) SS.
COUNTY OF JEFFERSON)

The foregoing Deed and Consideration Certificate were acknowledged, subscribed, and sworn to before me this 22nd day of December, 1998, by Lalit K. Sarin, individually and in his capacity as a Member of LKS PROPERTIES, LLC, a Kentucky limited liability company, to be the free act and voluntary deed of said company and his free act and voluntary deed as a managing member of LKS Properties, LLC.

My Commission expires: 7/2/02.

(SEAL) Notary Public

COMMONWEALTH OF KENTUCKY)
) SS.
COUNTY OF JEFFERSON)

The foregoing Deed and Consideration Certificate were acknowledged, subscribed, and sworn to before me this 22nd day of December, 1998, by Patricia A. Sarin to be her free act and voluntary deed.

My Commission expires: 7/2/02.

(SEAL) Notary Public

This instrument prepared by:

Lisa Ann Vogt
Lisa Ann Vogt, Esq.
Ogden Newell & Welch
1700 Citizens Plaza
500 West Jefferson Street
Louisville, Kentucky 40202
(502) 582-1601

0127528.02

DOCUMENT NO: 152068
RECORDED ON DECEMBER 23, 1998 10:27:32AM
TOTAL FEES: $14.00
COUNTY CLERK: SUE CAROLE PERRY
COUNTY: SHELBY COUNTY
DEPUTY CLERK: THERESA GRAVETT
BOOK D361 PAGES 181-184

PEARCE INDUSTRIAL RD
MCDANIELS RD
041-00-025
041-00-033
041-00-033A
041-00-026
041-00-027
041-00-032A
041-00-028
041-00-029
041-00-015A

SHELBY COUNTY PVA OFFICE

Shelbyville

Thursday, April 06, 2017

Name and Address	LKS PROPERTIES LLC 175 MCDANIELS ROAD SHELBYVILLE KY 40065-
Map Number	041-00-016
Property Address	MCDANIELS ROAD 175
Description	INDUSTRIAL PARK 22.25 AC & BLDG
District	02-Suburban Fire
Class	Commercial
Acres	22.25
Land	$1,174,000
Improvements	$0
Land and Improvements	$1,174,000
Deed Number	361-181
Sale Date	12/1/1998
Previous Owner	SARIN LALIT K

Authorized Signature

Reference 1

or loan guarantee or loan insurance program; and

(4) Acquisitions by or transfers to a government entity pursuant to seizure or forfeiture authority.

(b) Nothing in this section or in CERCLA section 101(20)(D) or section 101(35)(A)(ii) affects the applicability of 40 CFR 300.1100 to any security interest, property, or asset acquired pursuant to an involuntary acquisition or transfer, as described in this section.

NOTE TO PARAGRAPHS (A)(3) AND (B) OF THIS SECTION: Reference to 40 CFR 300.1100 is a reference to the provisions regarding secured creditors in CERCLA sections 101(20)(E)-(G), 42 U.S.C. 9601(20)(E)-(G). *See* Section 2504(a) of the Asset Conservation, Lender Liability, and Deposit Insurance Protection Act, Public Law, 104-208, 110 Stat. 3009-462, 3009-468 (1996).

APPENDIX A TO PART 300—THE HAZARD RANKING SYSTEM

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Reference 2

United States
Environmental Protection
Agency

Office of Emergency and
Remedial Response
Washington DC 20460

EPA/540/G-91/013
September 1991

EPA

Guidance for Performing Preliminary Assessments Under CERCLA

Reference 3

PRE-CERCLIS SCREENING ASSESSMENT

Guidance Manual

U.S. EPA Region 4 - Superfund Site Evaluation Section

August 2006

Reference 4

GENERAL WARRANTY DEED

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LALIT K. SARIN
5609 Wolf Pen Trace
Prospect, Kentucky 40059 (the "Grantor")

and

LKS PROPERTIES, LLC,
a Kentucky limited liability company
P.O. Box 308
Shelbyville, Kentucky 40065 (the "Grantee").

WITNESSETH:

For good and valuable consideration, receipt of which is acknowledged by Grantor, Grantor hereby grants and conveys unto the Partners and the Partners grant and convey unto Grantee in fee simple and with covenant of General Warranty the real property located in Shelby County, Kentucky and more fully described as follows:

BEGINNING at an iron pin in the eastern line of the Shelbyville Finishing Co. property, said point being N. 14 degrees 48 minutes E. 670.0 feet from the southeastern corner of the Shelbyville Finishing Co., opposite Station 25 + 20.9 of the Kentucky Highway S.P. 106-456 and running thence with the Finishing Company's line N. 14 degrees 48 minutes E. 627.1 feet to an iron pin in the southern margin of the Southern Railroad Company line; thence with the margin of said Railroad Company along a 1,125 foot radius curve in an easterly direction 399.4 feet to an iron pin; thence continuing with the margin of the Southern Railroad Company property S. 78 degrees 00 minutes E. 1063.2 feet to an iron post; corner to the McBride property; thence with McBride's line S. 2 degrees 10 minutes W. 641.0 feet to an iron pin; thence through the property of the Shelby County Industrial Development Corp., N. 79 degrees 12 minutes W. 1,565.8 feet to the beginning.

Together with all appurtenant rights, privileges and easements thereunto belonging, including, without limitation, the rights reserved by the Scott & Fetzer Company, Grantor's predecessor in interest, in paragraph 2 of section B of that certain deed dated April 18, 1973 between Laban P. Jackson, et al. and Shelby County, Kentucky, which Deed was filed for record in the Office of the County Clerk of Shelby County, Kentucky on April 27, 1973 and was recorded in Deed Book 180, Page 80.

BEING the same property acquired by Grantor by Deed dated October 22, 1990, of the record in Deed Book 266, page 594 in the office of the Clerk of Shelby County, Kentucky.

Grantor covenants lawful seisin of the estate hereby conveyed, full right and power to convey same and that said estate is free of encumbrances except (i) Mortgage of record in Mortgage Book 190, Page 676; (ii) Second Mortgage of record in Mortgage Book 190, Page 696; (iii) a financing statement of record in Mortgage Book 190, Page 708; (iv) financing statement of record in Mortgage Book 190, Page 711; and (v) an Assignment of Rents and Leases of record in Deed Book 248, Page 660 and liens for real property taxes and assessments due and payable in 1999, and thereafter, which the Grantee assumes and agrees to pay; however, this conveyance is made subject to easements, restrictions and stipulations of record and governmental laws and regulations affecting the Property herein conveyed.

To have and to hold the Property together with all of the rights, privileges, appurtenances and improvements thereunto belonging unto the Grantee, and its successors and assigns forever, with covenant of general warranty of title.

Patricia A. Sarin, the wife of Grantor, joins in this Deed solely for the purpose of conveying whatever dower interest she may have in the aforementioned described property.

This conveyance is exempt from transfer tax pursuant to KRS 142.050(7)(k).

Witness the signatures of the Grantor as of the day and year first above written.

GRANTOR:

L.K. Sarin

Lalit K. Sarin

Pat Sarin

Patricia A. Sarin

Consideration Certificate

We, the undersigned, do hereby certify, pursuant to KRS Chapter 382, that the property herein conveyed is transferred for nominal consideration and that the estimated fair cash value of the property herein conveyed is $ 1,174,000.

GRANTOR:

L.K. Sarin

Lalit K. Sarin

Pat Sarin

Patricia A. Sarin

GRANTEE:

LKS PROPERTIES, LLC
a Kentucky limited liability company

By: L.K. Sarin
Lalit K. Sarin, Member

COMMONWEALTH OF KENTUCKY)
) SS.
COUNTY OF JEFFERSON)

The foregoing Deed and Consideration Certificate were acknowledged, subscribed, and sworn to before me this 22nd day of December, 1998, by Lalit K. Sarin, individually and in his capacity as a Member of LKS PROPERTIES, LLC, a Kentucky limited liability company, to be the free act and voluntary deed of said company and his free act and voluntary deed as a managing member of LKS Properties, LLC.

My Commission expires: 7/2/02.

(SEAL)

Notary Public

COMMONWEALTH OF KENTUCKY)
) SS.
COUNTY OF JEFFERSON)

The foregoing Deed and Consideration Certificate were acknowledged, subscribed, and sworn to before me this 22nd day of December, 1998, by Patricia A. Sarin to be her free act and voluntary deed.

My Commission expires: 7/2/02.

(SEAL)

Notary Public

This instrument prepared by:

Lisa Ann Vogt

Lisa Ann Vogt, Esq.
Ogden Newell & Welch
1700 Citizens Plaza
500 West Jefferson Street
Louisville, Kentucky 40202
(502) 582-1601

0127528.02

DOCUMENT NO: 152068
RECORDED ON DECEMBER 23, 1998 10:27:32AM
TOTAL FEES: $14.00
COUNTY CLERK: SUE CAROLE PERRY
COUNTY: SHELBY COUNTY
DEPUTY CLERK: THERESA GRAVETT

BOOK D361 PAGES 181-184

Reference 5

PEARCE INDUSTRIAL RD
MCDANIELS RD
041-00-033
041-00-033A
041-00-027
041-00-025
041-00-028
041-00-030
041-00-029
041-00-015A
041-00-017

SHELBY COUNTY PVA OFFICE

Shelbyville

Thursday, April 06, 2017

Name and Address	LKS PROPERTIES LLC 175 MCDANIELS ROAD SHELBYVILLE KY 40065-
Map Number	041-00-016
Property Address	MCDANIELS ROAD 175
Description	INDUSTRIAL PARK 22.25 AC & BLDG
District	02-Suburban Fire
Class	Commercial
Acres	22.25
Land	$1,174,000
Improvements	$0
Land and Improvements	$1,174,000
Deed Number	361-181
Sale Date	12/1/1998
Previous Owner	SARIN LALIT K

Authorized Signature

Reference 6

Energy and Environmental Protection Cabinet
Department for Environmental Protection
Division of Waste Management

Site Inspection Report

Site/Permit ID: **39894 Mars Q615**			Regional Office: **Louisville**
Site Name: Shelby Industries			Program: Superfund
Site Address: 175 McDaniel Road, Shelbyville KY 40065			
City: Shelbyville	State: Kentucky	Zip: 400065	County: Shelby
Site Contact: Mr. William Yeager		Title: LKS Property Manager	Phone #: 502-718-3796
Inspection Type: Non-comprehensive	Purpose: Site Visit for Pre-CERCLA Screening		Not/Com #:
Inspection Dates: 4/6/17	Time: 10:30 am to 12:30 pm		
Latitude: 38.20500400	Longitude: -85.25772500		
Coordinate Collection Method: GPS +/- 90 Meters			
Type of Site: **Pre-CERCLA Screening (PCS) under PASI**			

I. Investigation Results

Findings/Violations/Recommendations:

At 8:45 am Daniel Phelps, PG, of the KY DEP – Superfund Branch arrived at the Louisville Field Office to discuss the recent history of the site and the goals for the Pre-CERCLA Screening (PCS) for the site visit with Ms. Lynn McAleer, an inspector with the Louisville Field Office. Ms. McAleer has been responsible for recent Hazardous Waste inspections at the site which have revealed numerous violations for unlabeled drums of hazardous waste staying on site for more than 90 days.

Phelps and McAleer arrived on the site at approximately 10:30 am EST. It was ~40º F and cloudy with occasional light rain. They met with Mr. William Yeager, an employee of LKS Properties (the current owner 502-718-3796) and Mr. Russell H. Brooks, PG, Senior Engineer, of the consultant Linebach Funkhouser, Inc. (502-895-5009). Mr. Yeager was a long-time employee of Shelby Industries when they operated the facility.

The interior of the warehouse building was observed. Four pits in the concrete where various pieces of equipment had formerly been located in the first large warehouse room on the east side of the building were viewed. These pits were filled in part with a mixture of water and machine oils as well as metal cuttings/filings. These pits are in the process of being remediated by consolidating and removing the pit contents. On the north end of the building there were many recently-labeled containers of hazardous waste. These containers included drums holding mixtures of water and hydrochloric acid, pickle liquor from zinc metal plating and processing, and various oils used in the machinery. Also present were open plastic containers containing similar hazardous waste. According to NOVs filed by Ms. McAleer, LKS properties has until April 24, 2017 to have these wastes properly disposed of or face enforcement action. The equipment making up the zinc plating line with numerous processing tanks was still in place. Supposedly, this plating line equipment will soon be sold and removed or else recycled. Powdered zinc residue, a non-hazardous waste, was observed in the vicinity of a chiller to the zinc plating line. There were also tanks present as part of separator system for waste water treatment. Mr. Yeager stated that Shelby Industries only did zinc plating since sometime before 1983.

Much of the rest of the interior of the building is leased by Pegasus Packing, Inc. Pegasus Packing has large amounts of cardboard, plastic bubble wrap and plastic sheeting, and styrofoam stored at the site. They use the site as a distribution center. Two (2) forklifts were active moving the packing materials to and from trucks for use elsewhere. Fewer than five (5) employees were on site, including Mr. Yeager of LKS Properties.

The areas surrounding the exterior of the building were also observed. A search was made for the three former lagoons described in a 1983 report as lying north of the building. In spite of a search based on the map in the 1983 report, there was no evidence of the lagoons; there were no changes in topography or major differences in vegetation where the maps indicated the lagoons had existed. Some areas had gravel fill, but this did not appear to correlate with the locations of the former lagoons. Further to the north of the building is a fence and heavily vegetated area. This fence, located on the property line, and vegetation separates the property from a steep drop off leading to an active railroad line.

West of the building a search was made for the area in which material removed from the lagoons was supposedly buried and capped. This area was mostly covered with shrubbery and small trees, but there were no noticeable changes in relief or vegetation in the vicinity of where the 1983 map indicated the capped material was located.

The area south of the building is a parking lot for visitors and the western portion of this lot features a loading dock where trucks are currently moving packing supplies.

The area east of the building is dominated by a large pond. The hummocky topography of the land immediately east of the pond suggests that the pond is not natural, but was excavated. Therefore the cattails and other features along the shore of the pond are not natural wetlands. The northeastern most portion of the property is a large open field. The southeastern most portion of the property (approximately 6 acres) has been set up as a Christmas tree farm with several types of pines and firs planted in neat rows.

The immediately surrounding properties are all light industrial and storage businesses that are part of a local industrial park off of Pearce Industrial Road. There are two subdivisions, off Old Finchville Road. One is located on Stuart Drive and the other on Victoria Drive, located less than ¼ mile east southeast of the site.

Businesses located north of the railroad tracks on the north side of the property from west to east include: Roll Forming Corporation, KU Storeroom, Shelbyville Asphalt Company, and Ohio Valley Aluminum. East of the Shelby Industries property are vacant fields and agricultural land. South of the property from west to east are Diesel Pro Kentucky, Inc., and Hieb Concrete Products, Inc. National Envelope (Blaze Products) Corporation lies west of Shelby Industries.

The property was exited after 12:30 pm.

After the site visit, Phelps went to the Shelby County PVA Office where he obtained an aerial photograph showing the parcel of land in question (Parcel Number 041-00-016). Phelps then proceeded to the Shelby County Clerk's office in the same building, where he obtained a copy of the deed for the site (Deed Book D361, Page 181-184).

Compliance Status - Not Applicable

II. Comments Including Remedial Measures and Expected Correction Dates

Comments: Not Applicable

III. Environmental/Human Health Impact

Findings/Violations/Recommendations:

Compliance Status - Not Applicable

IV. Documentation

- [x] Photos taken by Daniel Phelps, PG
- [ ] Record of visual determination of opacity
- [ ] Documents Obtained From Facility
- [ ] Samples taken by DEP
- [ ] Samples taken by outside source
- [ ] Regional Office instrument readings taken
- [ ] Other documentation
- [x] Site Hazard Assessment Completed

Comments:

Inspector:	Title:	Date:
Overall Compliance Status		
☐ **No violations observed**		
☐ **No violations observed but impending violation trends observed** – Advisory Action Taken		
☐ **Out of Compliance. Non-recurrent deficiency noted –** Verbal notice given or violation corrected at time of inspection.		
☐ **Out of Compliance. Non-recurrent administrative or O & M deficiency noted –** Warning Notice issued		
☐ **Out of Compliance** – NOV issued		

Received By: Daniel Phelps, PG	Title: Geologist Registered	Date: 4/10/17
Delivery Method:		

Figure 1. Eastern interior of Shelby Industries warehouse looking towards the north.


Figure 2. Pits filled with machine oil, water, and metal shavings on east side of the warehouse. Looking north.

Figure 3. Southernmost pit. Filled with absorbent material so oil and other liquids may be removed.

Figure 4. Second southernmost pit. Filled with oil, water, and metal shavings. Note deep red color of the liquid.

Figure 5. Third southernmost pit. Note oil staining.

Figure 6. Northernmost pit. At least 8 feet deep. Note oil/water and metal staining.

Figure 7. Four pits looking south.

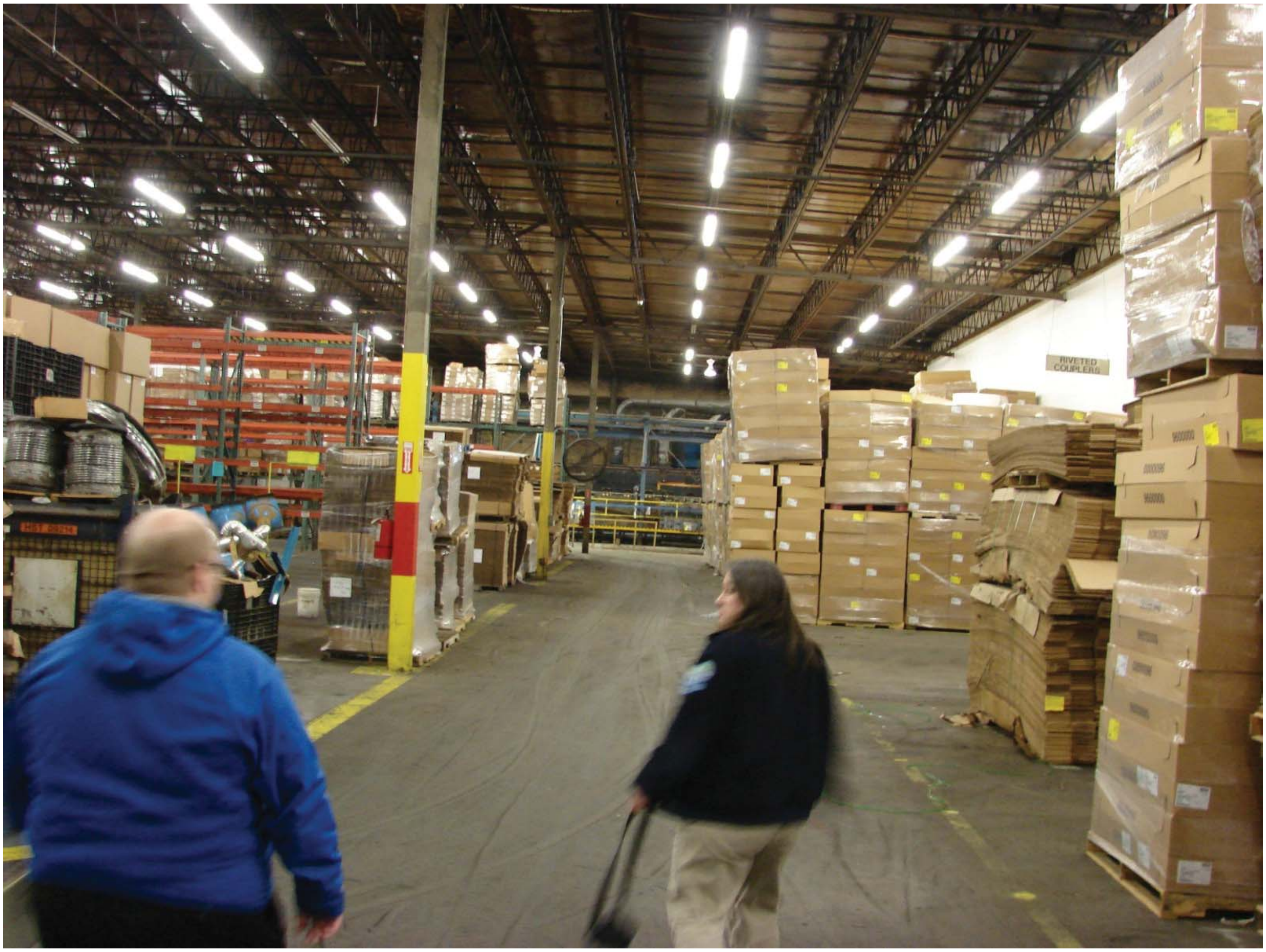

Figure 8. Area being used for storage of packing materials by Pegasus Packing.

Figure 9. Drums of hazardous waste on north side of building.

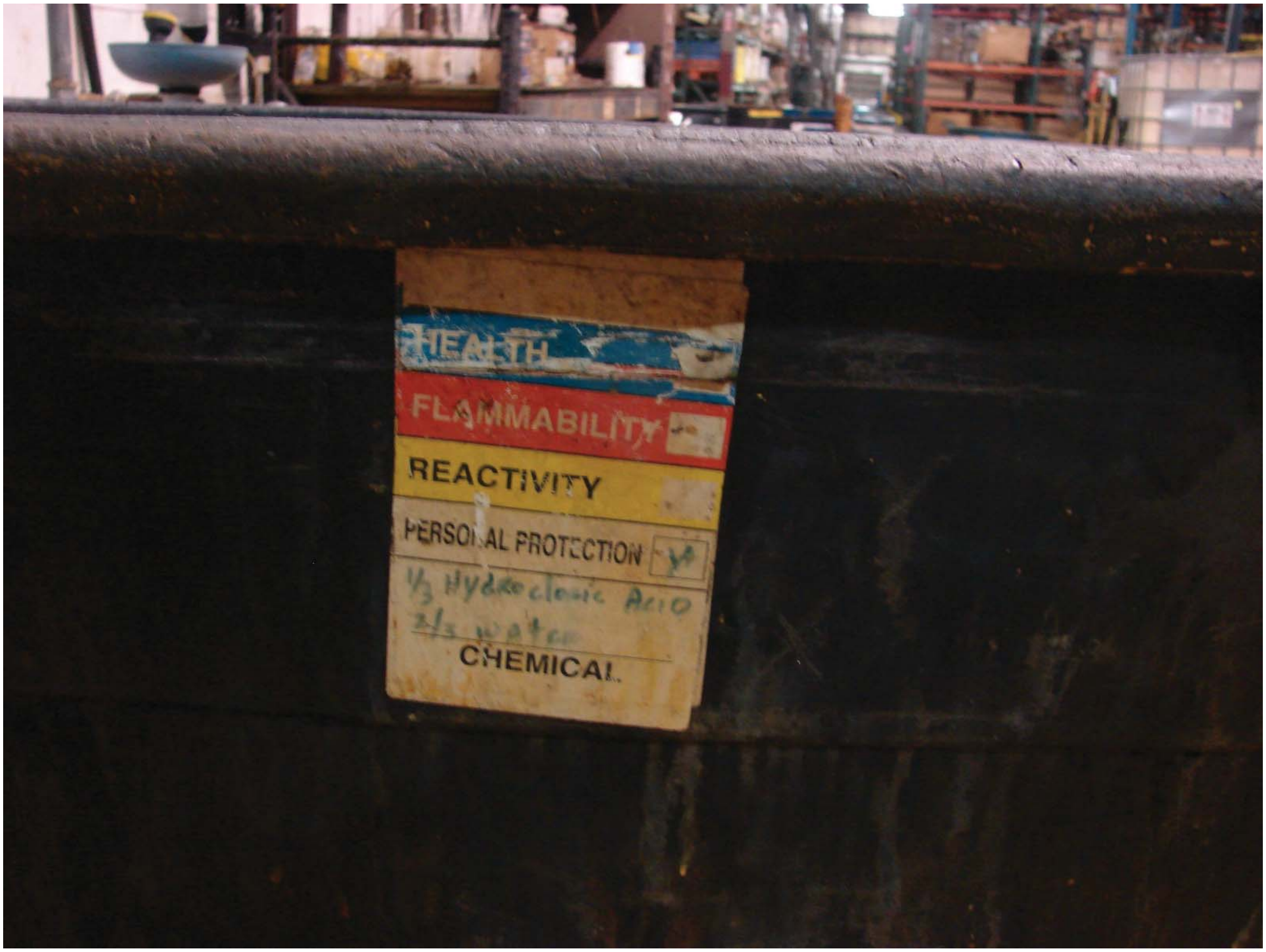

Figure 10. Open drum of 1/3 HCl, 2/3 water.

Figure 11. Equipment and waste drums in smaller room on north side of warehouse.

Figure 12. Zinc plating line next to wall. Hazardous waste drums, some still not properly labeled, in the foreground.

Figure 13. Area north of warehouse where former lagoons were mapped in 1983 report. Surface gravel does not correspond to position or shape of the lagoons.

Figure 14. Area North of warehouse where former lagoons were mapped in 1983 report.

Figure 15. Northern end of warehouse looking west to where capped area was mapped in 1983.

Figure 16. Northeastern corner of the building looking west to where former lagoons were mapped in 1983.

Figure 17. Zinc residue (non-hazardous waste) near chiller tank on north end of the warehouse.

Figure 18. Area west of the warehouse looking to the northeast corner of the building. The capped area mapped in 1983 would be in the vicinity of the northwest corner.

Figure 19. Vegetated area west of the building looking east towards the warehouse.

Figure 20. Vegetated area where capped material was mapped in 1983. No apparent changes in vegetation or topography evident.


Figure 21. Vegetated area west of warehouse.

Figure 22. West side of the warehouse.

Figure 23. Open hazardous waste container in northwestern portion of the warehouse. Probably "pickle liquor" spent/used acid from the zinc plating operation.

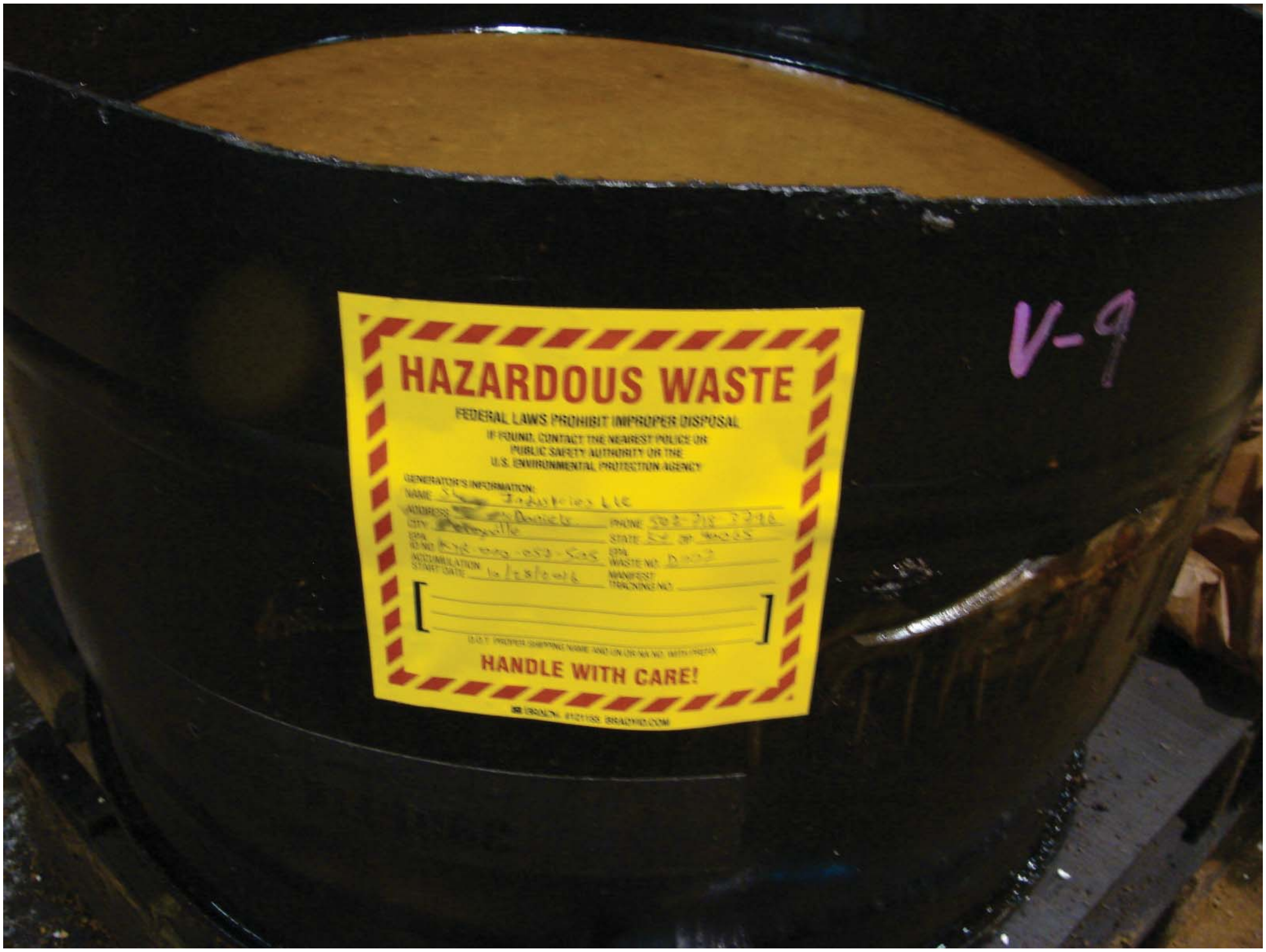

Figure 24. Close-up of open hazardous waste container's label. Probably spent "pickle liquor" D007 used acid from the zinc plating operation.

Figure 25. Zinc plating line looking from south to north. Northwestern portion of the warehouse.

Figure 26. Packing materials stored by Pegasus Packing.

Figure 27. Artificial pond located east of warehouse.

Figure 28. Southeast shore of pond. Note cattails.

Figure 29. East Shore of the pond.

Figure 30. Christmas tree farm on southeastern portion of the property.

Figure 31. View from just south of pond to the south towards the Christmas tree farm.

Figure 32. Parking lot and loading dock on the south side of the building.

Reference 7

Circular Area Profiling System (CAPS)

Version 10C Using Data from Summary File 1, 2010 Census

Ground Zero Coordinates: Latitude=38.20500400 , Longitude=85.25772500
Shelby Industries

Access the aggregated data as a csv file here: caps10c374996.csv

1-mile radius of specified point (Shelby Industries)

Subject	Number	Percent
1. Total Population Trends, Etc.		
Universe: Total Population		
Total Population	**2,369**	
Total Population 2000	**1,726**	
Change in Population 2000-2010	**643**	**37.3**
Males	**1,086**	**45.8**
Females	**1,283**	**54.2**
Population Density	**832.4**	
Land Area Sq. Miles	**3**	
2. Age		
Universe: Population		
Under 5 Years	**261**	**11.0**
Age 5 to 9 Years	**187**	**7.9**
10 to 14 Years	**169**	**7.1**
15 to 17 Years	**100**	**4.2**
18 to 19 Years	**58**	**2.4**
20 to 24 Years	**184**	**7.8**
25 to 34 Years	**411**	**17.3**
35 to 44 Years	**276**	**11.7**
45 to 54 Years	**271**	**11.4**
55 to 59 Years	**105**	**4.4**
Age60 to 64 Years	**86**	**3.6**
65 to 74 Years	**111**	**4.7**
75 to 84 Years	**91**	**3.8**
85 Years and Over	**59**	**2.5**
Median Age	31.2	

Subject	Number	Percent
Age 0 to 17	717	30.3
18 to 24 Years	242	10.2
25 to 44 Years	687	29.0
45 to 64 Years	462	19.5
62 Years and Over	320	13.5
65 Years and Over	261	11.0
3. Race		
Universe: Population		
One Race	**2,271**	**95.9**
White	1,542	65.1
Black or African American	477	20.1
American Indian and Alaska Native	4	0.2
Asian	19	0.8
Native Hawaiian and Other Pacific Islander	6	0.3
Some Other Race	223	9.4
Multi Race - Persons reporting more than one race	98	4.1
4. Hispanic or Latino and Race		
Universe: Hispanic or Latino Population		
Hispanic or Latino (of any race)	**561**	**23.7**
Mexican	NA	
Puerto Rican	NA	
Cuban	NA	
Other Hispanic or Latino	NA	
Not Hispanic or Latino	**1,808**	**76.3**
White Alone Not Hispanic	1,269	53.6
5. Relationship of Persons in Households		
Universe: Persons in Households		
Total Persons in Households	**2,313**	**97.6**
Householder	839	35.4
Spouse	295	12.5
Child	769	32.5
Own Child Under 18 Years	624	26.3
Other Relatives	236	10.0
Non Relatives	174	7.3

Subject	Number	Percent
Non-rel Under 18	12	0.5
Non-rel Over 65	4	0.2
Unmarried Partner	NA	
6. Households by Type		
Universe: Households		
Total Households	**839**	
Family Households (Families)	582	69.4
With Own Children Under 18 Years	331	39.5
Married Couple Family	295	35.2
With Own Children Under 18 Years	140	16.7
Female householder, No Husband Present	222	26.5
With Own Children Under 18 Years	154	18.4
Non Family Households	257	30.6
Unmarried Partner Households	NA	
Same-Sex Unmarried Partner HHs	NA	
Householder Living Alone	208	24.8
Householder 65 Years and Over	157	18.7
Households With Individuals Under 18 Years	370	44.1
7. Group Quarters		
Universe: Population Living in Group Quarters		
Population in Group Quarters	**56**	**2.4**
Institutionalized Population	56	2.4
Pop In Correctional Institutions	0	0.0
Pop in Nursing Homes	56	2.4
Pop in Other Institutions	0	0.0
NonInstitutionalized GQ Pop	0	0.0
College Dormitories (Includes college quarters off	0	0.0
Military Quarters	0	0.0
Other NonInstitutional GQ Pop	0	0.0
8. Housing Occupancy and Tenure		
Universe: Housing Units		
Total Housing Units	**967**	
Occupied Housing Units	839	86.8
Owner Occupied	311	37.1

Subject	Number	Percent
Renter Occupied	528	62.9
Vacant Housing Units	128	13.2
Vacant for Rent	52	5.4
Vacant for Sale	6	0.6
Vacant for Seasonal,Recreation or Occasional Use	0	0.0
Homeowner Vacancy Rate	1.89	
Rental Vacancy Rate	8.97	
Pop in Owner-occupied Units	783	33.1
Pop in Rented Units	1,530	64.6
Average Size of Owner-occupied Units	2.52	
Average Size of Renter-Occupied Units	2.90	

Note: Varibles showing "NA" are not available at the blocks level. Specify tracts as the units to be aggregated to get values for these items.

Summary of True Areas of Circles vs. That of Areas Selected to Estimate Them

(This Report Indicates How Well We Were Able to Approximate the Circular Area)

radius	Estimated	True Area	Ratio of Estimate to True Area
1	2.90	3.14	0.923

Auxiliary Report: Counties Contributing to Circular Areas, By Concentric Ring Areas Coordinates: (38.20500400 , 85.25772500)

Outer radius of Ring (or circle)=1

County Cd	Total Pop
Shelby KY	2,369
	2,369

Use this link to download the geocodes file (all geographic areas used)

Access the caps10c application at http://mcdc.missouri.edu/websas/caps10c.html

Missouri Census Data Center

Reference 8

www.nws.noaa.gov

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

Home | Site Map | News | Organization

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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: KY

Data description

Data type: Precipitation depth **Units:** English **Time series type:** Partial duration

Select location

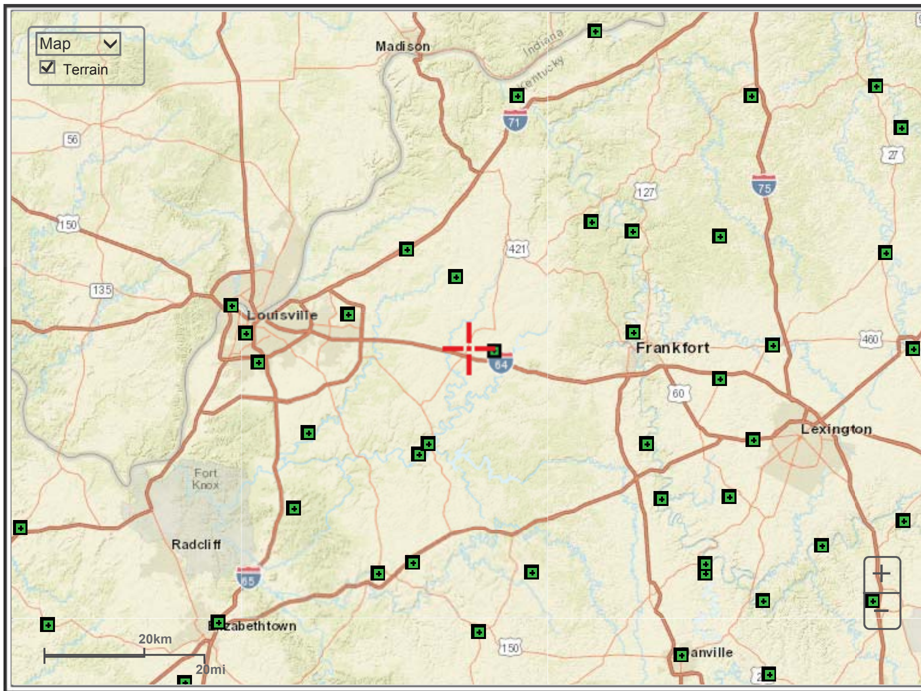
1) Manually:

a) By location (decimal degrees, use "-" for S and W): Latitude: 38.2050040 Longitude: -85.257725 Submit

b) By station (list of KY stations): Select station

c) By address Search

2) Use map (if ESRI interactive map is not loading, try adding the host: **http://js.arcgis.com/** to the firewall, or contact us at hdsc.questions@noaa.gov):



a) Select location
Move crosshair or double click

b) Click on station icon
☑ Show stations on map

Location information:
Name: Shelbyville, Kentucky, USA*
Latitude: 38.2050°
Longitude: -85.2577°
Elevation: 778.6 ft **

* Source: ESRI Maps
** Source: USGS

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3

PF tabular | PF graphical | Supplementary information | Print page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.379 (0.345-0.415)	0.447 (0.409-0.490)	0.525 (0.479-0.575)	0.589 (0.536-0.644)	0.667 (0.604-0.728)	0.729 (0.658-0.795)	0.789 (0.709-0.862)	0.852 (0.762-0.930)	0.933 (0.827-1.02)	0.995 (0.876-1.09)
10-min	0.592 (0.540-0.648)	0.701 (0.641-0.769)	0.819 (0.747-0.897)	0.913 (0.831-0.998)	1.03 (0.931-1.12)	1.11 (1.00-1.21)	1.20 (1.08-1.31)	1.28 (1.15-1.40)	1.39 (1.23-1.52)	1.47 (1.29-1.60)
15-min	0.726 (0.663-0.796)	0.861 (0.786-0.943)	1.01 (0.921-1.11)	1.13 (1.03-1.23)	1.27 (1.15-1.39)	1.38 (1.25-1.51)	1.49 (1.34-1.63)	1.60 (1.43-1.74)	1.73 (1.54-1.89)	1.83 (1.61-2.00)
30-min	0.967 (0.882-1.06)	1.16 (1.06-1.27)	1.39 (1.27-1.52)	1.57 (1.43-1.72)	1.81 (1.64-1.98)	1.99 (1.80-2.17)	2.17 (1.95-2.37)	2.35 (2.10-2.56)	2.59 (2.30-2.83)	2.77 (2.44-3.04)
60-min	1.18 (1.08-1.30)	1.43 (1.30-1.56)	1.75 (1.60-1.92)	2.01 (1.83-2.20)	2.36 (2.13-2.57)	2.63 (2.38-2.87)	2.91 (2.62-3.18)	3.20 (2.86-3.50)	3.60 (3.19-3.94)	3.92 (3.45-4.29)
2-hr	1.41 (1.29-1.54)	1.69 (1.55-1.85)	2.09 (1.91-2.28)	2.41 (2.19-2.62)	2.85 (2.59-3.10)	3.21 (2.90-3.49)	3.60 (3.23-3.90)	3.99 (3.57-4.34)	4.56 (4.04-4.95)	5.01 (4.42-5.46)
3-hr	1.52 (1.40-1.66)	1.83 (1.68-1.99)	2.25 (2.07-2.46)	2.61 (2.38-2.84)	3.11 (2.83-3.37)	3.52 (3.19-3.82)	3.95 (3.56-4.29)	4.42 (3.95-4.79)	5.08 (4.50-5.51)	5.63 (4.94-6.12)
6-hr	1.86 (1.71-2.02)	2.23 (2.05-2.43)	2.75 (2.52-3.00)	3.18 (2.92-3.47)	3.81 (3.47-4.14)	4.33 (3.92-4.70)	4.88 (4.39-5.30)	5.48 (4.89-5.95)	6.34 (5.60-6.89)	7.06 (6.17-7.69)
12-hr	2.21	2.65	3.27	3.77	4.50	5.11	5.76	6.45	7.45	8.28

	(2.03-2.42)	(2.43-2.91)	(2.99-3.58)	(3.45-4.13)	(4.09-4.92)	(4.61-5.58)	(5.16-6.29)	(5.74-7.05)	(6.55-8.15)	(7.21-9.09)
24-hr	**2.60** (2.42-2.84)	**3.12** (2.90-3.40)	**3.88** (3.59-4.22)	**4.51** (4.16-4.89)	**5.42** (4.98-5.88)	**6.19** (5.65-6.71)	**7.02** (6.37-7.61)	**7.92** (7.13-8.59)	**9.23** (8.21-10.0)	**10.3** (9.08-11.2)
2-day	**3.10** (2.88-3.35)	**3.72** (3.45-4.02)	**4.59** (4.26-4.96)	**5.31** (4.91-5.74)	**6.34** (5.83-6.84)	**7.19** (6.57-7.76)	**8.09** (7.35-8.73)	**9.05** (8.17-9.79)	**10.4** (9.31-11.3)	**11.6** (10.2-12.6)
3-day	**3.34** (3.11-3.60)	**4.00** (3.73-4.31)	**4.92** (4.58-5.30)	**5.67** (5.26-6.11)	**6.72** (6.21-7.25)	**7.59** (6.98-8.18)	**8.50** (7.77-9.16)	**9.46** (8.60-10.2)	**10.8** (9.73-11.7)	**11.9** (10.6-13.0)
4-day	**3.58** (3.34-3.85)	**4.28** (4.00-4.61)	**5.25** (4.90-5.64)	**6.02** (5.61-6.48)	**7.11** (6.60-7.65)	**7.99** (7.39-8.60)	**8.91** (8.19-9.59)	**9.87** (9.02-10.6)	**11.2** (10.2-12.1)	**12.3** (11.0-13.3)
7-day	**4.29** (4.01-4.60)	**5.11** (4.78-5.49)	**6.22** (5.81-6.69)	**7.15** (6.66-7.68)	**8.47** (7.85-9.10)	**9.55** (8.82-10.3)	**10.7** (9.84-11.5)	**11.9** (10.9-12.9)	**13.7** (12.4-14.8)	**15.1** (13.5-16.4)
10-day	**4.85** (4.54-5.21)	**5.78** (5.40-6.20)	**7.02** (6.55-7.53)	**8.04** (7.49-8.64)	**9.49** (8.80-10.2)	**10.7** (9.86-11.5)	**11.9** (11.0-12.8)	**13.3** (12.1-14.3)	**15.1** (13.7-16.4)	**16.7** (14.9-18.1)
20-day	**6.64** (6.26-7.04)	**7.87** (7.42-8.35)	**9.37** (8.83-9.94)	**10.6** (9.93-11.2)	**12.2** (11.4-12.9)	**13.5** (12.6-14.3)	**14.8** (13.7-15.7)	**16.1** (14.9-17.1)	**17.8** (16.4-19.0)	**19.2** (17.6-20.5)
30-day	**8.26** (7.84-8.69)	**9.75** (9.25-10.3)	**11.4** (10.8-12.0)	**12.7** (12.0-13.4)	**14.5** (13.6-15.2)	**15.8** (14.9-16.6)	**17.1** (16.1-18.0)	**18.4** (17.2-19.4)	**20.1** (18.7-21.3)	**21.4** (19.8-22.7)
45-day	**10.4** (9.95-10.9)	**12.2** (11.7-12.8)	**14.1** (13.5-14.8)	**15.5** (14.8-16.2)	**17.2** (16.4-18.1)	**18.5** (17.6-19.4)	**19.7** (18.7-20.7)	**20.9** (19.7-21.9)	**22.3** (21.0-23.4)	**23.3** (21.9-24.6)
60-day	**12.5** (11.9-13.1)	**14.6** (14.0-15.3)	**16.7** (16.0-17.5)	**18.3** (17.4-19.1)	**20.2** (19.3-21.1)	**21.6** (20.6-22.6)	**22.9** (21.8-24.0)	**24.1** (22.9-25.3)	**25.6** (24.3-27.0)	**26.7** (25.2-28.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in CSV format: Precipitation frequency estimates Submit

Main Link Categories:
Home | OWP

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Water Prediction (OWP)
1325 East West Highway
Silver Spring, MD 20910
Page Author: HDSC webmaster
Page last modified: April 21, 2017

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Reference 9

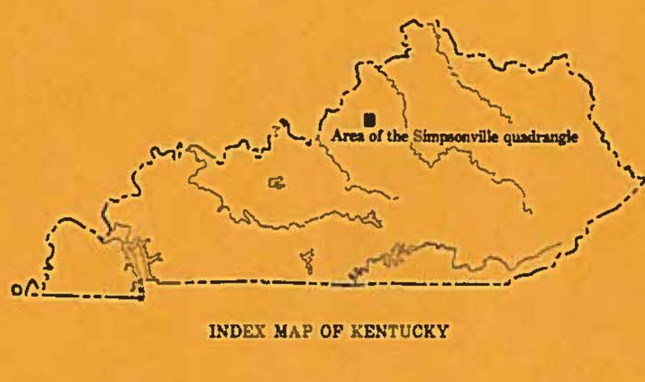
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY
UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
WALLACE W. HAGAN, DIRECTOR AND
STATE GEOLOGIST

GEOLOGIC QUADRANGLE MAPS OF THE UNITED STATES

GEOLOGIC MAP OF THE SIMPSONVILLE QUADRANGLE, SHELBY AND SPENCER COUNTIES, KENTUCKY

By
Warren L. Peterson



INDEX MAP OF KENTUCKY

PUBLISHED BY THE U.S. GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092
1978

PETERSON—SIMPSONVILLE, KY. 1:24,000 MAP GQ-1461

Reference 10

Groundwater Availability

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[Rock Descriptions](#)

Alluvium (Qa)
Topography
Alluvial flats are dissected by short, steep-sided gullies near tributaries.

Hydrology
The alluvium is too thin and fine grained to yield large amounts of water.

Laurel Dolomite (Slb)
Topography
The Laurel forms ledges and cliffs along streams.

Hydrology
The Laurel yields 100 to 500 gallons per day to wells on broad ridges and along streams, and yields water to small springs at the contact with the underlying Osgood Formation. Water is hard.

Osgood Formation (Slb)
Topography
The Osgood forms slopes between ledges.

Hydrology
The Osgood yields almost no water from shale, but does yield water to seeps from limestone. It impedes recharge to underlying rocks. Water is hard.

Brassfield Formation (Slb)
Topography
The Brassfield forms ledges on slopes and tops of small cliffs of underlying Saluda limestone.

Hydrology
The Brassfield yields almost no water to wells, but does yield water to seeps and small springs. Water is hard.

Drakes Formation (Saluda Dolomite, Bardstown, Rowland Members) (Od) and Bull Fork Formation (Ob)
Topography
These formations provide moderately dissected upland areas; slopes are modereately steep where shale predominates and less steep where limestone predominates. These rocks form steep slopes along large streams and cliffs; many slopes are dotted with weathered limestone slabs. Solutional features are evident where thick limestone beds underlie streams.

Hydrology
The Drakes and Bull Fork yield 100 to 500 gallons per day to wells in large stream valleys, and more where thick limestone is present. They yield almost no water to wells on hillsides and ridges, except in broad ridges in the upper part of the formation. They yield water to small springs. Water is hard and may contain salt in valley bottoms but is generally of good quality.

Grant Lake Limestone, Fairview Formation, Calloway Creek Limestone (Oaf)
Topography
These formations provide gently to moderately rolling uplands away from major streams. They are more highly dissected where shale content increases, and contain small sinkholes, minor underground drainage, and broad flat valleys where limestone predominates. The lower part forms broad, flat ridges between steep-sided valleys cut into underlying shale of the Kope or Clays Ferry Formations.

Hydrology
These formations yield 100 to 500 gallons per day to drilled wells in broad valleys and along

streams in uplands. They yield more than 500 gallons per day from thick limestone beds in the broad valley bottoms, but almost no water to drilled wells on hillsides or ridgetops. They also yield water to small springs and seeps. A limestone bed 15 feet thick in the lower part of the Grant Lake Limestone yields as much as 30 gallons per minute to springs. The sandy zone near the base yields little water. Water is hard and in valley bottoms may contain salt or hydrogen sulfide.

Clays Ferry Formation (Okc) and Kope Formation (Ok)
Topography
These formations create rugged topography of narrow, steep-sided ridges with narrow V-shaped valleys of dendritic drainage. Shales on steep slopes erode easily and are covered with thin limestone slabs in many places. The contrast with the less-rugged surface of the adjacent areas is marked, except near major streams. In the lower part of the formation topography becomes more gently to moderately rolling uplands, with small sinkholes and some underground drainage where limestone predominates.

Hydrology
These formations yields 100 to 500 gallons per day to drilled wells in large valley bottoms along streams, but almost no water to drilled wells on hillsides or ridgetops. They do yield water to small springs and seeps. Water is hard in valley bottoms and may contain salt or hydrogen sulfide.

Lexington Limestone (Millersburg Member, Tanglewood Limestone, Sulfur Well, Brannon, Grier, Logana Members) (Ol)
Topography
The Lexington Limestone lies in valley bottoms along the large tributaries.

Hydrology
The Lexington Limetone yields more than 500 gallons per day to wells in valley bottoms and 100 to 500 gallons per day to wells in small valleys. It yields water to springs. Water is hard and may contain salt or hydrogen sulfide in some places.

High Bridge Group (Ohb)
Topography
The High Bridge has no surface exposure in Shelby County, but underlies the entire area.

Hydrology
The High Bridge is not likely to yield usable amounts for any use; it is not considered an aquifer in this area.

Knox Group (Okx)
Topography
The Knox has no surface exposure in Kentucky, but underlies the entire state at varying depths.

Hydrology
In central Kentucky, fresh water has been found in the upper 100 to 250 feet of this largely untested dolomite-rich aquifer. Wells often exceed 750 feet in total depth, with high concentrations of dissolved solids found in many areas.

You can find out more about the Knox aquifer.

The U.S. Geological Survey's Hydrologic Atlas Series, published cooperatively with the Kentucky Geological Survey, provides hydrologic information for the entire state.

Previous--Next--Back to "Groundwater Resources in Kentucky"

Reference 11

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Shelby County, Kentucky

Shelby Industries

May 5, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:3,770 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 150, 300, 600, 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Shelby County, Kentucky
Survey Area Data: Version 14, Sep 19, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 3, 2011—Feb 20, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Shelby County, Kentucky (KY211)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
ShB	Shelbyville silt loam, 2 to 6 percent slopes	13.8	56.2%
uLfC	Lowell-Faywood silt loams, 6 to 12 percent slopes	10.0	40.7%
W	Water	0.8	3.2%
Totals for Area of Interest		**24.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Shelby County, Kentucky

ShB—Shelbyville silt loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2vtzs
Elevation: 480 to 1,190 feet
Mean annual precipitation: 38 to 66 inches
Mean annual air temperature: 40 to 68 degrees F
Frost-free period: 135 to 212 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Shelbyville and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Shelbyville

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Thin fine-silty noncalcareous loess over clayey residuum weathered from limestone

Typical profile

Ap - 0 to 9 inches: silt loam
Bt - 9 to 38 inches: silty clay loam
2Bt - 38 to 80 inches: silty clay

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Available water storage in profile: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Nicholson

Percent of map unit: 7 percent

Landform: Ridges
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Lowell

Percent of map unit: 4 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Faywood

Percent of map unit: 4 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

uLfC—Lowell-Faywood silt loams, 6 to 12 percent slopes

Map Unit Setting

National map unit symbol: 2s2d6
Elevation: 450 to 1,130 feet
Mean annual precipitation: 36 to 66 inches
Mean annual air temperature: 40 to 68 degrees F
Frost-free period: 144 to 218 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Lowell and similar soils: 70 percent
Faywood and similar soils: 20 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lowell

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey residuum weathered from limestone and shale

Typical profile

Ap - 0 to 8 inches: silt loam
Bt - 8 to 41 inches: silty clay
BC - 41 to 53 inches: silty clay
R - 53 to 63 inches: bedrock

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 40 to 57 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Faywood

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey residuum weathered from limestone and shale

Typical profile

Ap - 0 to 7 inches: silt loam
Bt - 7 to 29 inches: silty clay
R - 29 to 39 inches: bedrock

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 20 to 39 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Sandview

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Cynthiana

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

W—Water

Map Unit Setting

National map unit symbol: lj1t
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 40 to 65 degrees F
Frost-free period: 135 to 188 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

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Glossary

Many of the terms relating to landforms, geology, and geomorphology are defined in more detail in the “National Soil Survey Handbook.”

ABC soil

A soil having an A, a B, and a C horizon.

Ablation till

Loose, relatively permeable earthy material deposited during the downwasting of nearly static glacial ice, either contained within or accumulated on the surface of the glacier.

AC soil

A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil

The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil

Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial cone

A semiconical type of alluvial fan having very steep slopes. It is higher, narrower, and steeper than a fan and is composed of coarser and thicker layers of material deposited by a combination of alluvial episodes and (to a much lesser degree) landslides (debris flow). The coarsest materials tend to be concentrated at the apex of the cone.

Alluvial fan

A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes. It is shaped like an open fan or a segment of a cone. The material was deposited by a stream at the place where it issues from a narrow mountain valley or upland valley or where a tributary stream is near or at its junction with the main stream. The fan is steepest near its apex, which points upstream, and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

Alluvium

Unconsolidated material, such as gravel, sand, silt, clay, and various mixtures of these, deposited on land by running water.

Alpha,alpha-dipyridyl

A compound that when dissolved in ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction implies reducing conditions and the likely presence of redoximorphic features.

Animal unit month (AUM)

The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions

Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Argillic horizon

A subsoil horizon characterized by an accumulation of illuvial clay.

Arroyo

The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in unconsolidated material. It is usually dry but can be transformed into a temporary watercourse or short-lived torrent after heavy rain within the watershed.

Aspect

The direction toward which a slope faces. Also called slope aspect.

Association, soil

A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity)

The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low: 0 to 3
Low: 3 to 6
Moderate: 6 to 9
High: 9 to 12
Very high: More than 12

Backslope

The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

Backswamp

A flood-plain landform. Extensive, marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces.

Badland

A landscape that is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes and narrow interfluves. Badlands develop on surfaces that have little or no vegetative cover overlying unconsolidated or poorly cemented materials (clays, silts, or sandstones) with, in some cases, soluble minerals, such as gypsum or halite.

Bajada

A broad, gently inclined alluvial piedmont slope extending from the base of a mountain range out into a basin and formed by the lateral coalescence of a series of alluvial fans. Typically, it has a broadly undulating transverse profile, parallel to the mountain front, resulting from the convexities of component fans. The term is generally restricted to constructional slopes of intermontane basins.

Basal area

The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation

The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Base slope (geomorphology)

A geomorphic component of hills consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

Bedding plane

A planar or nearly planar bedding surface that visibly separates each successive layer of stratified sediment or rock (of the same or different lithology) from the preceding or following layer; a plane of deposition. It commonly marks a change in the circumstances of deposition and may show a parting, a color difference, a change in particle size, or various combinations of these. The term is commonly applied to any bedding surface, even one that is conspicuously bent or deformed by folding.

Bedding system

A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock

The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography

A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace

A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum

Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout (map symbol)

A saucer-, cup-, or trough-shaped depression formed by wind erosion on a preexisting dune or other sand deposit, especially in an area of shifting sand or loose soil or where protective vegetation is disturbed or destroyed. The adjoining accumulation of sand derived from the depression, where recognizable, is commonly included. Blowouts are commonly small.

Borrow pit (map symbol)

An open excavation from which soil and underlying material have been removed, usually for construction purposes.

Bottom land

An informal term loosely applied to various portions of a flood plain.

Boulders

Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks

A landscape or tract of steep, rough or broken land dissected by ravines and gullies and marking a sudden change in topography.

Breast height

An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management

Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte

An isolated, generally flat-topped hill or mountain with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments; commonly topped by a caprock of resistant material and representing an erosion remnant carved from flat-lying rocks.

Cable yarding

A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

Calcareous soil

A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche

A general term for a prominent zone of secondary carbonate accumulation in surficial materials in warm, subhumid to arid areas. Caliche is formed by both geologic and pedologic processes. Finely crystalline calcium carbonate forms a nearly continuous surface-coating and void-filling medium in geologic (parent) materials. Cementation ranges from weak in nonindurated forms to very strong in indurated forms. Other minerals (e.g., carbonates, silicate, and sulfate) may occur as accessory cements. Most petrocalcic horizons and some calcic horizons are caliche.

California bearing ratio (CBR)

The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy

The leafy crown of trees or shrubs. (See Crown.)

Canyon

A long, deep, narrow valley with high, precipitous walls in an area of high local relief.

Capillary water

Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena

A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material and under similar climatic conditions but that have different characteristics as a result of differences in relief and drainage.

Cation

An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity

The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps

See Terracettes.

Cement rock

Shaly limestone used in the manufacture of cement.

Channery soil material

Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment

Control of unwanted vegetation through the use of chemicals.

Chiseling

Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Cirque

A steep-walled, semicircular or crescent-shaped, half-bowl-like recess or hollow, commonly situated at the head of a glaciated mountain valley or high on the side of a mountain. It was produced by the erosive activity of a mountain glacier. It commonly contains a small round lake (tarn).

Clay

As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions

See Redoximorphic features.

Clay film

A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clay spot (map symbol)

A spot where the surface texture is silty clay or clay in areas where the surface layer of the soils in the surrounding map unit is sandy loam, loam, silt loam, or coarser.

Claypan

A dense, compact subsoil layer that contains much more clay than the overlying materials, from which it is separated by a sharply defined boundary. The layer restricts the downward movement of water through the soil. A claypan is commonly hard when dry and plastic and sticky when wet.

Climax plant community

The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil

Sand or loamy sand.

Cobble (or cobblestone)

A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material

Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

COLE (coefficient of linear extensibility)

See Linear extensibility.

Colluvium

Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g., direct gravitational action) and by local, unconcentrated runoff.

Complex slope

Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil

A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions

See Redoximorphic features.

Conglomerate

A coarse grained, clastic sedimentary rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system

Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage

A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil

Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the “Soil Survey Manual.”

Contour stripcropping

Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section

The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat)

A type of limnic layer composed predominantly of fecal material derived from aquatic animals.

Corrosion (geomorphology)

A process of erosion whereby rocks and soil are removed or worn away by natural chemical processes, especially by the solvent action of running water, but also by other reactions, such as hydrolysis, hydration, carbonation, and oxidation.

Corrosion (soil survey interpretations)

Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop

A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management

Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system

Growing crops according to a planned system of rotation and management practices.

Cross-slope farming

Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown

The upper part of a tree or shrub, including the living branches and their foliage.

Cryoturbate

A mass of soil or other unconsolidated earthy material moved or disturbed by frost action. It is typically coarser than the underlying material.

Cuesta

An asymmetric ridge capped by resistant rock layers of slight or moderate dip (commonly less than 15 percent slopes); a type of homocline produced by differential erosion of interbedded resistant and weak rocks. A cuesta has a long, gentle slope on one side (dip slope) that roughly parallels the inclined beds; on the other side, it has a relatively short and steep or clifflike slope (scarp) that cuts through the tilted rocks.

Culmination of the mean annual increment (CMAI)

The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave

The walls of excavations tend to cave in or slough.

Decreasers

The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing

Postponing grazing or resting grazing land for a prescribed period.

Delta

A body of alluvium having a surface that is fan shaped and nearly flat; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer

A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depression, closed (map symbol)

A shallow, saucer-shaped area that is slightly lower on the landscape than the surrounding area and that does not have a natural outlet for surface drainage.

Depth, soil

Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Desert pavement

A natural, residual concentration or layer of wind-polished, closely packed gravel, boulders, and other rock fragments mantling a desert surface. It forms where wind action and sheetwash have removed all smaller particles or where rock fragments have migrated upward through sediments to the surface. It typically protects the finer grained underlying material from further erosion.

Diatomaceous earth

A geologic deposit of fine, grayish siliceous material composed chiefly or entirely of the remains of diatoms.

Dip slope

A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace)

A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming

A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural)

Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the “Soil Survey Manual.”

Drainage, surface

Runoff, or surface flow of water, from an area.

Drainageway

A general term for a course or channel along which water moves in draining an area. A term restricted to relatively small, linear depressions that at some time move concentrated water and either do not have a defined channel or have only a small defined channel.

Draw

A small stream valley that generally is shallower and more open than a ravine or gulch and that has a broader bottom. The present stream channel may appear inadequate to have cut the drainageway that it occupies.

Drift

A general term applied to all mineral material (clay, silt, sand, gravel, and boulders) transported by a glacier and deposited directly by or from the ice or transported by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

Drumlin

A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It commonly has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longer axis is parallel to the general direction of glacier flow. Drumlins are products of streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition.

Duff

A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Dune

A low mound, ridge, bank, or hill of loose, windblown granular material (generally sand), either barren and capable of movement from place to place or covered and stabilized with vegetation but retaining its characteristic shape.

Earthy fill

See Mine spoil.

Ecological site

An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

Eluviation

The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation

A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian deposit

Sand-, silt-, or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

Ephemeral stream

A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation

A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion

The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (accelerated)

Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion (geologic)

Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion pavement

A surficial lag concentration or layer of gravel and other rock fragments that remains on the soil surface after sheet or rill erosion or wind has removed the finer soil particles and that tends to protect the underlying soil from further erosion.

Erosion surface

A land surface shaped by the action of erosion, especially by running water.

Escarpment

A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Most commonly applied to cliffs produced by differential erosion. Synonym: scarp.

Escarpment, bedrock (map symbol)

A relatively continuous and steep slope or cliff, produced by erosion or faulting, that breaks the general continuity of more gently sloping land surfaces. Exposed material is hard or soft bedrock.

Escarpment, nonbedrock (map symbol)

A relatively continuous and steep slope or cliff, generally produced by erosion but in some places produced by faulting, that breaks the continuity of more gently sloping land surfaces. Exposed earthy material is nonsoil or very shallow soil.

Esker

A long, narrow, sinuous, steep-sided ridge of stratified sand and gravel deposited as the bed of a stream flowing in an ice tunnel within or below the ice (subglacial) or between ice walls on top of the ice of a wasting glacier and left behind as high ground when the ice melted. Eskers range in length from less than a kilometer to more than 160 kilometers and in height from 3 to 30 meters.

Extrusive rock

Igneous rock derived from deep-seated molten matter (magma) deposited and cooled on the earth's surface.

Fallow

Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan remnant

A general term for landforms that are the remaining parts of older fan landforms, such as alluvial fans, that have been either dissected or partially buried.

Fertility, soil

The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat)

The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity

The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fill slope

A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil

Sandy clay, silty clay, or clay.

Firebreak

An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom

An obsolete, informal term loosely applied to the lowest flood-plain steps that are subject to regular flooding.

Flaggy soil material

Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone

A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain

The nearly level plain that borders a stream and is subject to flooding unless protected artificially.

Flood-plain landforms

A variety of constructional and erosional features produced by stream channel migration and flooding. Examples include backswamps, flood-plain splays, meanders, meander belts, meander scrolls, oxbow lakes, and natural levees.

Flood-plain splay

A fan-shaped deposit or other outspread deposit formed where an overloaded stream breaks through a levee (natural or artificial) and deposits its material (commonly coarse grained) on the flood plain.

Flood-plain step

An essentially flat, terrace-like alluvial surface within a valley that is frequently covered by floodwater from the present stream; any approximately horizontal surface still actively modified by fluvial scour and/or deposition. May occur individually or as a series of steps.

Fluvial

Of or pertaining to rivers or streams; produced by stream or river action.

Foothills

A region of steeply sloping hills that fringes a mountain range or high-plateau escarpment. The hills have relief of as much as 1,000 feet (300 meters).

Footslope

The concave surface at the base of a hillslope. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb

Any herbaceous plant not a grass or a sedge.

Forest cover

All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type

A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragipan

A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Genesis, soil

The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai

Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Glaciofluvial deposits

Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

Glaciolacustrine deposits

Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are bedded or laminated.

Gleyed soil

Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping

Growing crops in strips that grade toward a protected waterway.

Grassed waterway

A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel

Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravel pit (map symbol)

An open excavation from which soil and underlying material have been removed and used, without crushing, as a source of sand or gravel.

Gravelly soil material

Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Gravelly spot (map symbol)

A spot where the surface layer has more than 35 percent, by volume, rock fragments that are mostly less than 3 inches in diameter in an area that has less than 15 percent rock fragments.

Green manure crop (agronomy)

A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water

Water filling all the unblocked pores of the material below the water table.

Gully (map symbol)

A small, steep-sided channel caused by erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage whereas a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock

Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hard to reclaim

Reclamation is difficult after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Hardpan

A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head slope (geomorphology)

A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Hemic soil material (mucky peat)

Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops

Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill

A generic term for an elevated area of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline. Slopes are generally more than 15 percent. The distinction between a hill and a mountain is arbitrary and may depend on local usage.

Hillslope

A generic term for the steeper part of a hill between its summit and the drainage line, valley flat, or depression floor at the base of a hill.

Horizon, soil

A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the “Soil Survey Manual.” The major horizons of mineral soil are as follows:

O horizon: An organic layer of fresh and decaying plant residue.

L horizon: A layer of organic and mineral limnic materials, including coprogenous earth (sedimentary peat), diatomaceous earth, and marl.

A horizon: The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon: The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon: The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon: The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon: Soft, consolidated bedrock beneath the soil.

R layer: Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

M layer: A root-limiting subsoil layer consisting of nearly continuous, horizontally oriented, human-manufactured materials.

W layer: A layer of water within or beneath the soil.

Humus

The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups

Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties include depth to a seasonal high water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock

Rock that was formed by cooling and solidification of magma and that has not been changed appreciably by weathering since its formation. Major varieties include plutonic and volcanic rock (e.g., andesite, basalt, and granite).

Illuviation

The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil

A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers

Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration

The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity

The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate

The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate

The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Very low: Less than 0.2
Low: 0.2 to 0.4
Moderately low: 0.4 to 0.75
Moderate: 0.75 to 1.25
Moderately high: 1.25 to 1.75
High: 1.75 to 2.5
Very high: More than 2.5

Interfluve

A landform composed of the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction. An elevated area between two drainageways that sheds water to those drainageways.

Interfluve (geomorphology)

A geomorphic component of hills consisting of the uppermost, comparatively level or gently sloping area of a hill; shoulders of backwearing hillslopes can narrow the upland or can merge, resulting in a strongly convex shape.

Intermittent stream

A stream, or reach of a stream, that does not flow year-round but that is commonly dry for 3 or more months out of 12 and whose channel is generally below the local water table. It flows only during wet periods or when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders

On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions

See Redoximorphic features.

Irrigation

Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin: Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border: Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding: Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation: Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle): Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow: Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler: Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation: Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding: Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame

A low mound, knob, hummock, or short irregular ridge composed of stratified sand and gravel deposited by a subglacial stream as a fan or delta at the margin of a melting glacier; by a supraglacial stream in a low place or hole on the surface of the glacier; or as a ponded deposit on the surface or at the margin of stagnant ice.

Karst (topography)

A kind of topography that formed in limestone, gypsum, or other soluble rocks by dissolution and that is characterized by closed depressions, sinkholes, caves, and underground drainage.

Knoll

A small, low, rounded hill rising above adjacent landforms.

Ksat

See Saturated hydraulic conductivity.

Lacustrine deposit

Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain

A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

Lake terrace

A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landfill (map symbol)

An area of accumulated waste products of human habitation, either above or below natural ground level.

Landslide

A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials caused by gravitational forces; the movement may or may not involve saturated materials. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones

Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Lava flow (map symbol)

A solidified, commonly lobate body of rock formed through lateral, surface outpouring of molten lava from a vent or fissure.

Leaching

The removal of soluble material from soil or other material by percolating water.

Levee (map symbol)

An embankment that confines or controls water, especially one built along the banks of a river to prevent overflow onto lowlands.

Linear extensibility

Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at $^1/_3$- or $^1/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

Liquid limit

The moisture content at which the soil passes from a plastic to a liquid state.

Loam

Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess

Material transported and deposited by wind and consisting dominantly of silt-sized particles.

Low strength

The soil is not strong enough to support loads.

Low-residue crops

Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Marl

An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under freshwater lacustrine conditions but also formed in more saline environments.

Marsh or swamp (map symbol)

A water-saturated, very poorly drained area that is intermittently or permanently covered by water. Sedges, cattails, and rushes are the dominant vegetation in marshes, and trees or shrubs are the dominant vegetation in swamps. Not used in map units where the named soils are poorly drained or very poorly drained.

Mass movement

A generic term for the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress.

Masses

See Redoximorphic features.

Meander belt

The zone within which migration of a meandering channel occurs; the flood-plain area included between two imaginary lines drawn tangential to the outer bends of active channel loops.

Meander scar

A crescent-shaped, concave or linear mark on the face of a bluff or valley wall, produced by the lateral erosion of a meandering stream that impinged upon and undercut the bluff.

Meander scroll

One of a series of long, parallel, close-fitting, crescent-shaped ridges and troughs formed along the inner bank of a stream meander as the channel migrated laterally down-valley and toward the outer bank.

Mechanical treatment

Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil

Very fine sandy loam, loam, silt loam, or silt.

Mesa

A broad, nearly flat topped and commonly isolated landmass bounded by steep slopes or precipitous cliffs and capped by layers of resistant, nearly horizontal rocky material. The summit width is characteristically greater than the height of the bounding escarpments.

Metamorphic rock

Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement at depth in the earth’s crust. Nearly all such rocks are crystalline.

Mine or quarry (map symbol)

An open excavation from which soil and underlying material have been removed and in which bedrock is exposed. Also denotes surface openings to underground mines.

Mine spoil

An accumulation of displaced earthy material, rock, or other waste material removed during mining or excavation. Also called earthy fill.

Mineral soil

Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage

Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area

A kind of map unit that has little or no natural soil and supports little or no vegetation.

Miscellaneous water (map symbol)

Small, constructed bodies of water that are used for industrial, sanitary, or mining applications and that contain water most of the year.

Moderately coarse textured soil

Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil

Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon

A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine

In terms of glacial geology, a mound, ridge, or other topographically distinct accumulation of unsorted, unstratified drift, predominantly till, deposited primarily by the direct action of glacial ice in a variety of landforms. Also, a general term for a landform composed mainly of till (except for kame moraines, which are composed mainly of stratified outwash) that has been deposited by a glacier. Some types of moraines are disintegration, end, ground, kame, lateral, recessional, and terminal.

Morphology, soil

The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil

Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Mountain

A generic term for an elevated area of the land surface, rising more than 1,000 feet (300 meters) above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are formed primarily by tectonic activity and/or volcanic action but can also be formed by differential erosion.

Muck

Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mucky peat

See Hemic soil material.

Mudstone

A blocky or massive, fine grained sedimentary rock in which the proportions of clay and silt are approximately equal. Also, a general term for such material as clay, silt, claystone, siltstone, shale, and argillite and that should be used only when the amounts of clay and silt are not known or cannot be precisely identified.

Munsell notation

A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon

A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil

A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules

See Redoximorphic features.

Nose slope (geomorphology)

A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent. Nose slopes consist dominantly of colluvium and slope-wash sediments (for example, slope alluvium).

Nutrient, plant

Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter

Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low: Less than 0.5 percent
Low: 0.5 to 1.0 percent
Moderately low: 1.0 to 2.0 percent
Moderate: 2.0 to 4.0 percent
High: 4.0 to 8.0 percent
Very high: More than 8.0 percent

Outwash

Stratified and sorted sediments (chiefly sand and gravel) removed or “washed out” from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice.

Outwash plain

An extensive lowland area of coarse textured glaciofluvial material. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Paleoterrace

An erosional remnant of a terrace that retains the surface form and alluvial deposits of its origin but was not emplaced by, and commonly does not grade to, a present-day stream or drainage network.

Pan

A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material

The unconsolidated organic and mineral material in which soil forms.

Peat

Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped

An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment

A layer of sediment, eroded from the shoulder and backslope of an erosional slope, that lies on and is being (or was) transported across a gently sloping erosional surface at the foot of a receding hill or mountain slope.

Pedon

The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation

The movement of water through the soil.

Perennial water (map symbol)

Small, natural or constructed lakes, ponds, or pits that contain water most of the year.

Permafrost

Ground, soil, or rock that remains at or below 0 degrees C for at least 2 years. It is defined on the basis of temperature and is not necessarily frozen.

pH value

A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil

A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

Piping

Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Pitting

Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plastic limit

The moisture content at which a soil changes from semisolid to plastic.

Plasticity index

The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plateau (geomorphology)

A comparatively flat area of great extent and elevation; specifically, an extensive land region that is considerably elevated (more than 100 meters) above the adjacent lower lying terrain, is commonly limited on at least one side by an abrupt descent, and has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level.

Playa

The generally dry and nearly level lake plain that occupies the lowest parts of closed depressions, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff. Playa deposits are fine grained and may or may not have a high water table and saline conditions.

Plinthite

The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Plowpan

A compacted layer formed in the soil directly below the plowed layer.

Ponding

Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded

Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Pore linings

See Redoximorphic features.

Potential native plant community

See Climax plant community.

Potential rooting depth (effective rooting depth)

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning

Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil

The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil

A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use

Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Rangeland

Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil

A measure of acidity or alkalinity of a soil, expressed as pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid: Less than 3.5

Extremely acid: 3.5 to 4.4

Very strongly acid: 4.5 to 5.0

Strongly acid: 5.1 to 5.5

Moderately acid: 5.6 to 6.0

Slightly acid: 6.1 to 6.5

Neutral: 6.6 to 7.3

Slightly alkaline: 7.4 to 7.8

Moderately alkaline: 7.9 to 8.4

Strongly alkaline: 8.5 to 9.0

Very strongly alkaline: 9.1 and higher

Red beds

Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations

See Redoximorphic features.

Redoximorphic depletions

See Redoximorphic features.

Redoximorphic features

Redoximorphic features are associated with wetness and result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redoximorphic processes in a soil may result in redoximorphic features that are defined as follows:

1. Redoximorphic concentrations.—These are zones of apparent accumulation of iron-manganese oxides, including:
   A. Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure; *and*
   B. Masses, which are noncemented concentrations of substances within the soil matrix; *and*
   C. Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.
2. Redoximorphic depletions.—These are zones of low chroma (chromas less than those in the matrix) where either iron-manganese oxides alone or both iron-manganese oxides and clay have been stripped out, including:
   A. Iron depletions, i.e., zones that contain low amounts of iron and manganese oxides but have a clay content similar to that of the adjacent matrix; *and*
   B. Clay depletions, i.e., zones that contain low amounts of iron, manganese, and clay (often referred to as silt coatings or skeletans).
3. Reduced matrix.—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

Reduced matrix

See Redoximorphic features.

Regolith

All unconsolidated earth materials above the solid bedrock. It includes material weathered in place from all kinds of bedrock and alluvial, glacial, eolian, lacustrine, and pyroclastic deposits.

Relief

The relative difference in elevation between the upland summits and the lowlands or valleys of a given region.

Residuum (residual soil material)

Unconsolidated, weathered or partly weathered mineral material that accumulated as bedrock disintegrated in place.

Rill

A very small, steep-sided channel resulting from erosion and cut in unconsolidated materials by concentrated but intermittent flow of water. A rill generally is not an obstacle to wheeled vehicles and is shallow enough to be smoothed over by ordinary tillage.

Riser

The vertical or steep side slope (e.g., escarpment) of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural, steplike landforms, such as successive stream terraces.

Road cut

A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments

Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop (map symbol)

An exposure of bedrock at the surface of the earth. Not used where the named soils of the surrounding map unit are shallow over bedrock or where “Rock outcrop” is a named component of the map unit.

Root zone

The part of the soil that can be penetrated by plant roots.

Runoff

The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil

A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Saline spot (map symbol)

An area where the surface layer has an electrical conductivity of 8 mmhos/cm more than the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has an electrical conductivity of 2 mmhos/cm or less.

Sand

As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone

Sedimentary rock containing dominantly sand-sized particles.

Sandy spot (map symbol)

A spot where the surface layer is loamy fine sand or coarser in areas where the surface layer of the named soils in the surrounding map unit is very fine sandy loam or finer.

Sapric soil material (muck)

The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturated hydraulic conductivity (Ksat)

The ease with which pores of a saturated soil transmit water. Formally, the proportionality coefficient that expresses the relationship of the rate of water movement to hydraulic gradient in Darcy's Law, a law that describes the rate of water movement through porous media. Commonly abbreviated as "Ksat." Terms describing saturated hydraulic conductivity are:

Very high: 100 or more micrometers per second (14.17 or more inches per hour)

High: 10 to 100 micrometers per second (1.417 to 14.17 inches per hour)

Moderately high: 1 to 10 micrometers per second (0.1417 inch to 1.417 inches per hour)

Moderately low: 0.1 to 1 micrometer per second (0.01417 to 0.1417 inch per hour)

Low: 0.01 to 0.1 micrometer per second (0.001417 to 0.01417 inch per hour)

Very low: Less than 0.01 micrometer per second (less than 0.001417 inch per hour).

To convert inches per hour to micrometers per second, multiply inches per hour by 7.0572. To convert micrometers per second to inches per hour, multiply micrometers per second by 0.1417.

Saturation

Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification

The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock

A consolidated deposit of clastic particles, chemical precipitates, or organic remains accumulated at or near the surface of the earth under normal low temperature and pressure conditions. Sedimentary rocks include consolidated equivalents of alluvium, colluvium, drift, and eolian, lacustrine, and marine deposits. Examples are sandstone, siltstone, mudstone, claystone, shale, conglomerate, limestone, dolomite, and coal.

Sequum

A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil

A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Severely eroded spot (map symbol)

An area where, on the average, 75 percent or more of the original surface layer has been lost because of accelerated erosion. Not used in map units in which “severely eroded,” “very severely eroded,” or “gullied” is part of the map unit name.

Shale

Sedimentary rock that formed by the hardening of a deposit of clay, silty clay, or silty clay loam and that has a tendency to split into thin layers.

Sheet erosion

The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Short, steep slope (map symbol)

A narrow area of soil having slopes that are at least two slope classes steeper than the slope class of the surrounding map unit.

Shoulder

The convex, erosional surface near the top of a hillslope. A shoulder is a transition from summit to backslope.

Shrink-swell

The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Shrub-coppice dune

A small, streamlined dune that forms around brush and clump vegetation.

Side slope (geomorphology)

A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel. Side slopes are dominantly colluvium and slope-wash sediments.

Silica

A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio

The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt

As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone

An indurated silt having the texture and composition of shale but lacking its fine lamination or fissility; a massive mudstone in which silt predominates over clay.

Similar soils

Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole (map symbol)

A closed, circular or elliptical depression, commonly funnel shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock (e.g., limestone, gypsum, or salt) or by collapse of underlying caves within bedrock. Complexes of sinkholes in carbonate-rock terrain are the main components of karst topography.

Site index

A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides (pedogenic)

Grooved, striated, and/or glossy (shiny) slip faces on structural peds, such as wedges; produced by shrink-swell processes, most commonly in soils that have a high content of expansive clays.

Slide or slip (map symbol)

A prominent landform scar or ridge caused by fairly recent mass movement or descent of earthy material resulting from failure of earth or rock under shear stress along one or several surfaces.

Slope

The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope alluvium

Sediment gradually transported down the slopes of mountains or hills primarily by nonchannel alluvial processes (i.e., slope-wash processes) and characterized by particle sorting. Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Burnished peds and sorting of rounded or subrounded pebbles or cobbles distinguish these materials from unsorted colluvial deposits.

Slow refill

The slow filling of ponds, resulting from restricted water transmission in the soil.

Slow water movement

Restricted downward movement of water through the soil. See Saturated hydraulic conductivity.

Sodic (alkali) soil

A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodic spot (map symbol)

An area where the surface layer has a sodium adsorption ratio that is at least 10 more than that of the surface layer of the named soils in the surrounding map unit. The surface layer of the surrounding soils has a sodium adsorption ratio of 5 or less.

Sodicity

The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to Ca^{++} + Mg^{++}. The degrees of sodicity and their respective ratios are:

Slight: Less than 13:1

Moderate: 13-30:1

Strong: More than 30:1

Sodium adsorption ratio (SAR)

A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

Soft bedrock

Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil

A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

Soil separates

Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand: 2.0 to 1.0

Coarse sand: 1.0 to 0.5

Medium sand: 0.5 to 0.25

Fine sand: 0.25 to 0.10

Very fine sand: 0.10 to 0.05

Silt: 0.05 to 0.002

Clay: Less than 0.002

Solum

The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Spoil area (map symbol)

A pile of earthy materials, either smoothed or uneven, resulting from human activity.

Stone line

In a vertical cross section, a line formed by scattered fragments or a discrete layer of angular and subangular rock fragments (commonly a gravel- or cobble-sized lag concentration) that formerly was draped across a topographic surface and was later buried by additional sediments. A stone line generally caps material that was subject to weathering, soil formation, and erosion before burial. Many stone lines seem to be buried erosion pavements, originally formed by sheet and rill erosion across the land surface.

Stones

Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony

Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stony spot (map symbol)

A spot where 0.01 to 0.1 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surrounding soil has no surface stones.

Strath terrace

A type of stream terrace; formed as an erosional surface cut on bedrock and thinly mantled with stream deposits (alluvium).

Stream terrace

One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream; represents the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition.

Stripcropping

Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil

The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are:

Platy: Flat and laminated
Prismatic: Vertically elongated and having flat tops
Columnar: Vertically elongated and having rounded tops
Angular blocky: Having faces that intersect at sharp angles (planes)
Subangular blocky: Having subrounded and planar faces (no sharp angles)
Granular: Small structural units with curved or very irregular faces

Structureless soil horizons are defined as follows:

Single grained: Entirely noncoherent (each grain by itself), as in loose sand
Massive: Occurring as a coherent mass

Stubble mulch

Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil

Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling

Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum

The part of the soil below the solum.

Subsurface layer

Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow

The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Summit

The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

Surface layer

The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil

The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus

Rock fragments of any size or shape (commonly coarse and angular) derived from and lying at the base of a cliff or very steep rock slope. The accumulated mass of such loose broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts

Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine

An end moraine that marks the farthest advance of a glacier. It typically has the form of a massive arcuate or concentric ridge, or complex of ridges, and is underlain by till and other types of drift.

Terrace (conservation)

An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geomorphology)

A steplike surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, lake, or seashore. The term is usually applied both to the relatively flat summit surface (tread) that was cut or built by stream or wave action and to the steeper descending slope (scarp or riser) that has graded to a lower base level of erosion.

Terracettes

Small, irregular steplike forms on steep hillslopes, especially in pasture, formed by creep or erosion of surficial materials that may be induced or enhanced by trampling of livestock, such as sheep or cattle.

Texture, soil

The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer

Otherwise suitable soil material that is too thin for the specified use.

Till

Dominantly unsorted and nonstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are embedded within a finer matrix that can range from clay to sandy loam.

Till plain

An extensive area of level to gently undulating soils underlain predominantly by till and bounded at the distal end by subordinate recessional or end moraines.

Tilth, soil

The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope

The gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil

The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements

Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Tread

The flat to gently sloping, topmost, laterally extensive slope of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural steplike landforms, such as successive stream terraces.

Tuff

A generic term for any consolidated or cemented deposit that is 50 percent or more volcanic ash.

Upland

An informal, general term for the higher ground of a region, in contrast with a low-lying adjacent area, such as a valley or plain, or for land at a higher elevation than the flood plain or low stream terrace; land above the footslope zone of the hillslope continuum.

Valley fill

The unconsolidated sediment deposited by any agent (water, wind, ice, or mass wasting) so as to fill or partly fill a valley.

Variegation

Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve

A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Very stony spot (map symbol)

A spot where 0.1 to 3.0 percent of the soil surface is covered by rock fragments that are more than 10 inches in diameter in areas where the surface of the surrounding soil is covered by less than 0.01 percent stones.

Water bars

Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering

All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth's surface by atmospheric or biologic agents or by circulating surface waters but involving essentially no transport of the altered material.

Well graded

Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wet spot (map symbol)

A somewhat poorly drained to very poorly drained area that is at least two drainage classes wetter than the named soils in the surrounding map unit.

Wilting point (or permanent wilting point)

The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow

The uprooting and tipping over of trees by the wind.

Reference 12

1983-05-01 Waste Disposal Investigation Report

RETECH

A Resource Technology Company
Consultants in the Environmental & Resource Sciences

Shelbyville Facility
Waste Disposal Investigations

for

Valley Industries

Valley Industries
Automotive and recreational
vehicle products

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INTRODUCTION

Purpose of this study for Valley Industries is two fold: (1) to determine if a waste from the chromium electroplating operation was disposed onsite; (2) if waste residue was still on-site the waste volume and level of contamination were to be determined along with potential for offsite migration of contaminants.

The study consisted of a review of past waste disposal activities at Valley Industries' plant in Shelbyville, Kentucky. Past disposal areas were identified through discussions with plant personnel, historical aerial photography and an onsite drilling program. Soil and surface water samples were used to determine present level of contamination and potential for offsite migration of contaminants.

This report is divided into the following sections, Introduction, Waste Management History, Regional Setting, Site Investigations, and Environmental Assessment. The Waste Management History Section contains a review of plant ownership, manufacturing processes, types of waste treatment, and locations of waste disposal. Regional Setting Section contains an overview of the geology, soils and surface and ground water resources of the area. Similar site specific information is contained in the Site Setting Section. The Site Investigations Sections describes the surface soil and waste residue analyzes which were performed. Also the waste analysis results are compared to various environmental standards. The Environmental Assessment Section contains an analysis of the potential for offsite migration of contaminants and level of hazard.

SUMMARY

Valley Industries operated a chromium electroplating operation near Shelbyville, Kentucky from 1974 until 1982. In 1982 Valley Industries stopped chromium electroplating and leased a portion of their manufacturing facilities which included a zinc electroplating line to Shelby Industries.

During the period from 1974 to 1978 settled solids from spent chromium electroplating solution was discharged to lagoons (approximately 180 cubic yards of semisolid material) a total of three lagoons existed during this period of time. Also in 1977 the lake onsite was cleaned and at least some of the residue was used as fill on the west side of the manufacturing building. Also one of the three lagoons was cleaned prior to closure and waste may have been placed in this area, too.

RETECH was retained to locate the closed lagoons, determine if waste residue is in the lagoon areas, and assess Valley Industries closure options. Through assistance of the plant personnel and historical aerial photographs, the location of the lagoons was determined. The areal extent, depth and the contents of the lagoons was confirmed with an extensive drilling and sampling program.

Only, Lagoon Areas #1 and #2 contain a residue which is 6 to 10 inches thick (approximately 22 and 14 cubic yards, respectively). This material, has cadmium, chromium and nickel concentrations which are 13, 5 and 30 times above background levels. The EP toxicity results of this waste for nickel indicate levels which are less than 25 percent of levels which denote a hazardous waste. Levels for cadmium and chromium are all less than the 10 percent of concentration levels of hazardous waste. Also, the clay cover over this waste meets the hazardous waste disposal standard which require 4 feet of cover with permability of 10^{-7} cm/sec.

The Waste Area contains, approximately 500 cubic yards of waste with similar levels of cadmium, chromium and nickel as found in the lagoon area. Leachability (EP toxicity analysis) levels are lower than material from the lagoons. These levels are all less than 10 percent of the levels used to denote a hazardous waste.

In addition to soil samples, surface water samples were analyzed from waters which receive surface runoff from the area. Levels of cadmium, chromium and nickel were quite low and are within the levels acceptable for a public drinking water source and propagation of fish and wildlife. Ground water in the area of the waste was not sampled because it is not of sufficient quantity to be a drinking water source.

Based on surface water samples and level of contamination in the waste and two lagoon areas, no environmental hazard exists. There is no need, therefore, to remove waste for offsite disposal. Physical closure of the two lagoons with a 4 to 6 foot clay cap is environmentally acceptable. The waste area contains material of such low leachability that there is no need for further containment action.

FINDINGS AND CONCLUSIONS

FINDINGS

Listed below are our findings based on our investigation

- Onsite disposal of chromium electroplating waste occurred from 1974 until 1978.
- Approximately 180 cubic yards of semi-solid waste was generated from 1974 to 1978.
- From 1974 to 1978 three lagoons were used to store settled solids from the electroplating solutions.
- Lagoon Area #1 was closed in 1975, Lagoon Area #2 was closed in 1978 and Lagoon Area #3 was cleaned and closed in 1978.
- Lagoon Area #1 still contains approximately 22 cubic yards of residue and Lagoon Area #2 contains about 14 cubic yards.
- An onsite lake was drained and six inches of residue removed on June 15, 1977.
- A Waste Area exists west of the manufacturing buildup. This area may contain residue from the lake and also one or more of the lagoons.
- Approximately 500 cubic yards of material are in the waste area. Waste is in mounds 2.5 to 3 feet high.
- Based on the levels of contamination and volume of residue in the waste and lagoons areas, it appears at least some of the waste generated from 1974 to 1978 was disposed offsite.
- Waste residue in Lagoon Area #1 was analyzed using the EP toxicity procedure. This test indicates nickel is 26.3 percent of the delist standard while cadmium and nickel are less than 2 percent of the maximum contaminant level standards.
- Analysis of waste residue in Lagoon Area #2 using EP toxicity test shows metal results which are less than 7 percent of standards.
- Analysis of waste residue from the Waste Area using EP toxicity test shows metal concentrations which are 10 percent or less of standards.
- Cap material on Lagoon Areas #1 and #2 is 4 to 6 feet thick and has a permability of 10^{-7} cm/sec. or less.
- There is no ground water resource under or adjacent to the lagoons and waste areas.
- Surface water quality adjacent to the site meets the metal standards for public water supply and propogation of fish and wildlife.

CONCLUSIONS

- Three factors reduce potential for offsite migration of contamination

  1) small quanity of waste material with low levels of metal concentration

  2) lack of ground water under or adjacent to the waste

  3) site soils are low in permability

Therefore, it appears that the waste will not cause any environmental contamination.

WASTE MANAGEMENT HISTORY

In 1973 The Scott and Fetzer Company purchased property in the Shelbyville Industrial Park and had a manufacturing facility constructed (Figure 1). This site was leased by Valley Tow-Rite. Ownership of the facility has not changed to date. Both lease holders and types of manufacturing activities have changed since 1973.

From 1973 to 1974 no electroplating occurred on site. In 1974, Valley Tow-Rite installed a non-cyanide nickel/chromium electroplating line to chrome trailer hitches. A zinc electroplating line was added in 1978. Paint operations at the plant have always used a powder epoxy system that is alkaline cleaned.

In 1979 Valley Tow-Rite's name was changed to Valley Industries due to diversification of the product line. Valley Industries subleased half the building to Shelby Industries in 1982. About this same time Valley Industries stopped their nickel/chromium electroplating line. Shelby Industries plans to continue using both the zinc electroplating and powder epoxy paint lines. Valley Industries is in the process of selling the nickel/ chromium line.

The nickel/chromium electroplating line is the only source of hazardous waste (EPA #F006). Two types of processes were tried to treat the spent solutions from the line. Originally the line was purchased with waste savers (an evaporation system) for waste treatment. This system was designed for zero discharge of waste material but it did not work. A filter press system was installed in 1978 which results in residue that is disposed off site by ILWD, a hazardous waste disposal company. This system treats solutions from both the nickel/chromium line and zinc line.

During the period of time between 1974 and 1978, several lagoons were constructed north of the building (Figure 2). These lagoons received settled waste solutions from the nickel/chromium line. Also during this period some discharge of plating solutions to the lake on-site occurred. This lake along with one or more of the lagoons were cleaned and at least some of the residue was piled in an area west of the building.

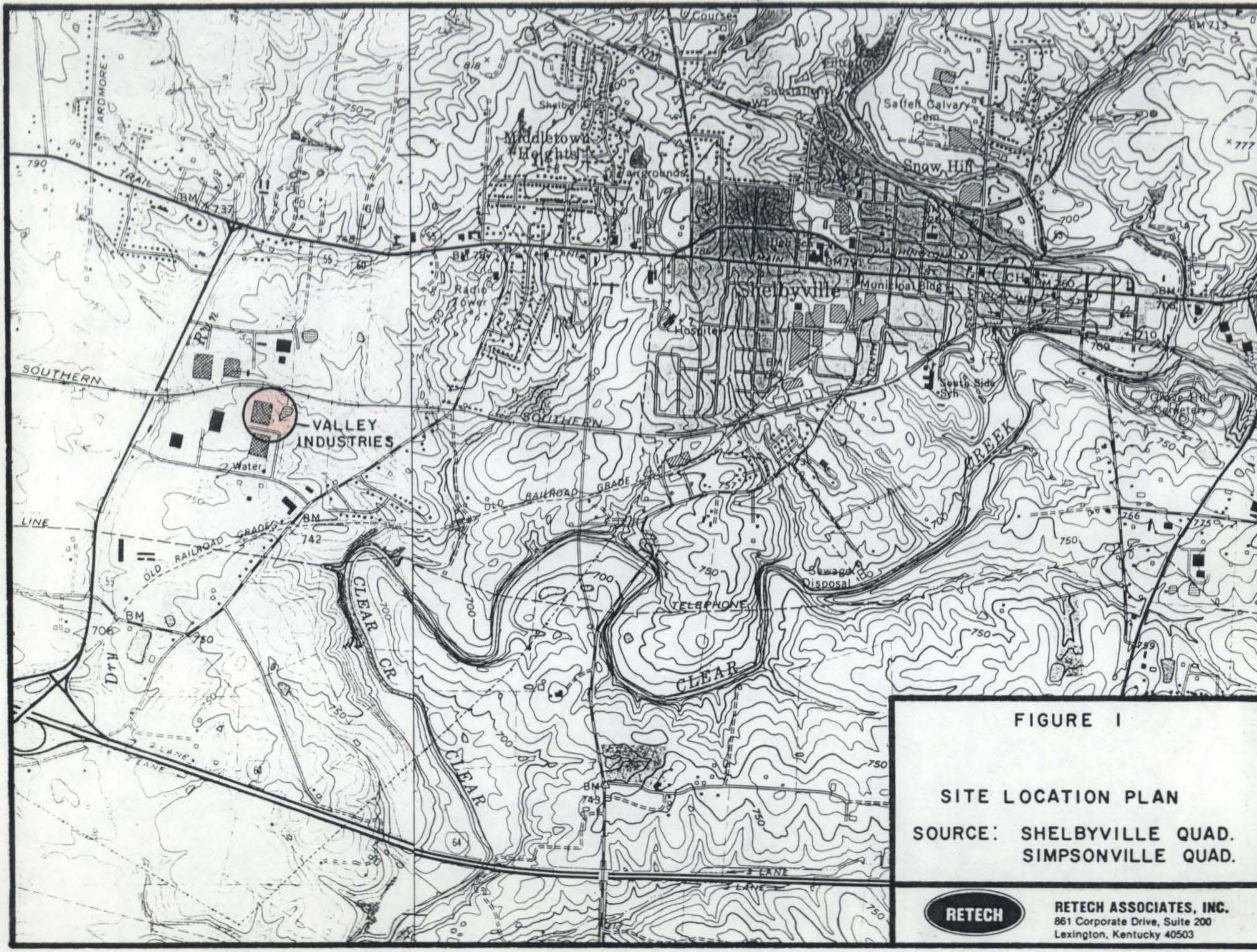


FIGURE I

SITE LOCATION PLAN

SOURCE: SHELBYVILLE QUAD.
SIMPSONVILLE QUAD.

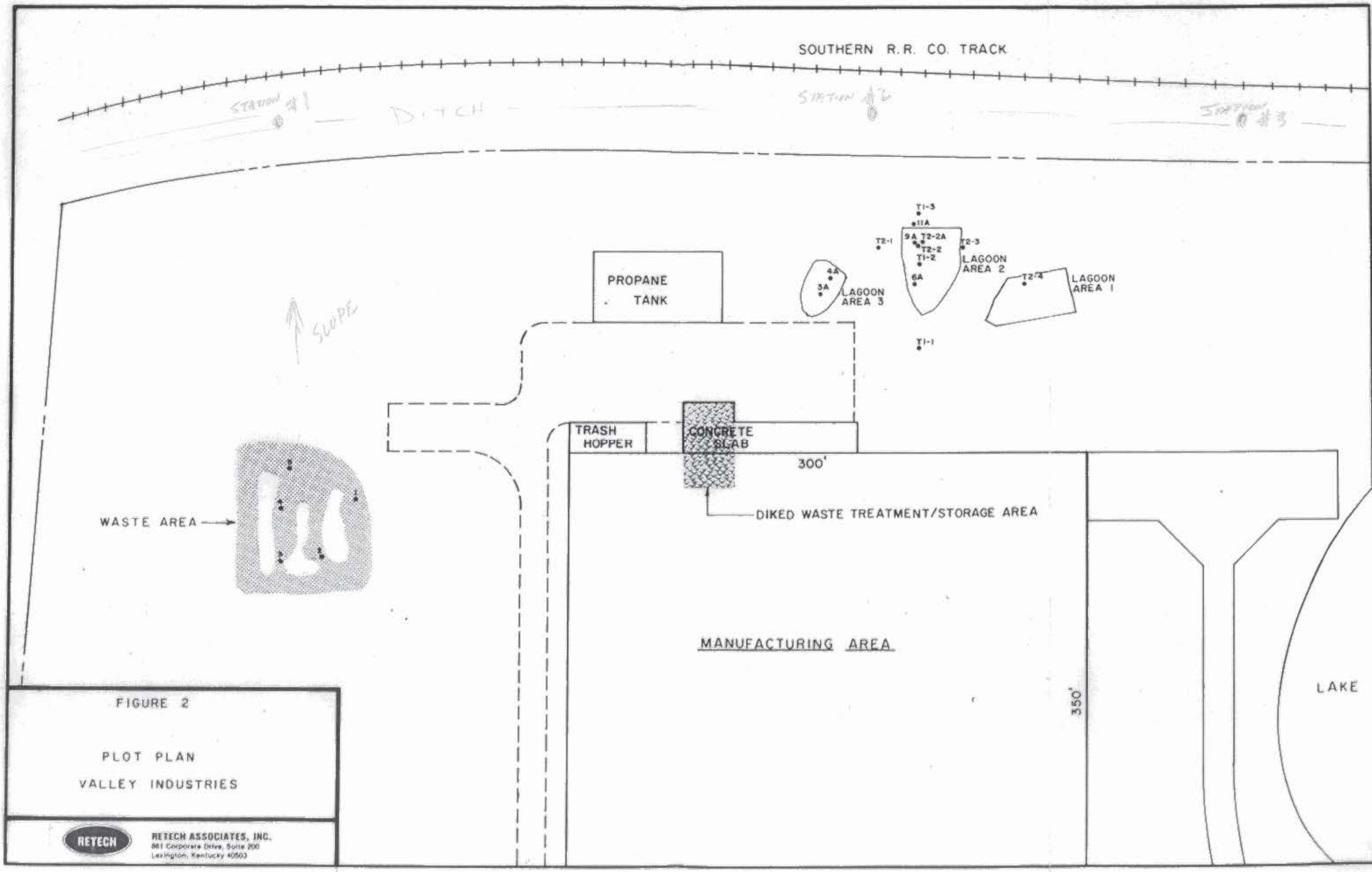


FIGURE 2

PLOT PLAN

VALLEY INDUSTRIES

Information on the chronology of the waste lagoons was obtained from historical aerial photography, discussions with plant personnel, and contractor bills. A summary of known information is as follows:

1) Lagoon #1 is visible on aerial photography dated May 10, 1975.
2) Lagoon #2 was constructed September-November 1975 based on contractor bills.
3) Aerial photography dated April 9, 1976 shows Lagoon #1 was closed.
4) Lake was cleaned June 15, 1977 (contractor bills).
5) Lagoon #2 was closed and Lagoon #3 was constructed in January, 1978 (contractor bills).
6) Lagoon #3 was cleaned and closed in September, 1978 (contractor bills).

With the advent of the filter press, process waste was placed in a 20 cubic yard "roll on" and shipped to a commercial hazardous waste disposal site. Current volume of waste generation is about 20 cubic yards every nine months. During the period the lagoon existed, production levels and associated waste generation were higher according to plant personnel. They estimate that about 20 cubic yards of equivalent type of solid residue was placed in the lagoons every six months. Using this assumption approximately 180 cubic yards of residue was routed to the lagoons or lake from 1974 to 1978.

REGIONAL SETTING

The plant site is located in Shelby County approximately one mile west of Shelbyville, Kentucky (Figure 1). Physio-graphically, the area is in the western part of the Blue Grass region, which is nearly coextensive with the area of outcrop of Ordovician rocks in Central Kentucky. The Shelby County consists of gently rolling farmland with hilltop at altitudes of 800 to 850 feet. The hilltops are underlain locally be the Great Lakes Limestone formation which has a maximum depth of 160 feet (Figure 3). Soil overlying unit is commonly 5 to 10 feet thick on ridgetops, 4 to 6 feet thick on gentle valley sides and 0.5 to 3 feet thick on steep valley sides.

Peterson, 1978 reported the structural contours drawn on top of the Calloway Creek Limestone (bottom of the Great Lake Limestone) dip in a westerly direction across Shelby County. At the plant site the dip is due west and averages about 20 feet per mile.

Previous nomenclature used for the Great Lakes Limestone by McFarlan and Withers, 1950 include the lower part of the Arnheim and all of the McMillan Formations. Hall and Palmquist, Jr. (1960) described the formations and their water bearing characteristics as follows:

> Arnheim Formation: Bluish-gray lumpy claystone and thin-bedded shale with much interbedded irregular, knotty, rubbly limestone. Water yield is 100 to 500 gpd to drilled wells in valley bottom; yield almost no water to drilled wells on hillsides or ridgetops.
>
> McMillian Formation: Thin to medium-bedded rubbly argillaceous limestone with much shale. Thin locally crossbedded crystalline rubby limestone with no shale in lower part. Water yield is 100 to 500 gpd to drilled wells in valley bottoms, but almost no water to wells on hills; yield some water through springs and seeps.

Figure 4 denotes areas where these formations produce 100 to 500 gpd at depths less than 100 feet. In Shelby County these areas are limited to Brashears Creek drainage which includes Clear Creek and Bullskin Creek. Clear Creek and Dry Run boarders the plant site.

NOMENCLATURE OF EARLIER WORKERS	SYSTEM	SERIES	FORMATION AND MEMBER		THICKNESS, IN FEET	DESCRIPTION
McFarlan and Others, 19[illegible]	QUATERNARY		Alluvium		0-20?	Silt, clay, sand, and gravel. Dominantly floodplain, minor channel deposits. Floodplain deposits are silt and clay; channel deposits are sand and gravel. Gravel composed dominantly of clasts less than a foot in largest dimension that were derived from local limestone bedrock.
Liberty	ORDOVICIAN	Upper Ordovician	Drakes Formation	Bardstown Member	58+	Not exposed in quadrangle but inferred to be present on some hilltops in northwestern part. Inference based on thickness of about 50 feet of underlying Rowland Member of Drakes Formation in [illegible] quadrangle ([illegible], 19[illegible]) adjacent on the west. Composed of interbedded limestone, dolostone, and shale in [illegible] quadrangle.
Waynesville				Rowland Member	95+ / 50±	Rarely exposed in quadrangle at time of mapping. [illegible]
Arnheim			Grant Lake Limestone		180	Limestone and shale. Limestone (about 75 percent) is medium gray to olive gray, composed of [illegible]
McMillan						
Bellevue						

FIGURE 3
GENERALIZED STRATOGRAPHIC COLUMNS

RETECH

RETECH ASSOCIATES, INC.
[illegible]

SITE SETTING

Three lagoons which received plating waste existed at various intervals from 1974 to 1979. These lagoons were small with the largest covering less than 1000 square feet of surface area. No more than two lagoons existed at any one time. Simultaneous existance of lagoons was brief and only covered the period needed to close the older lagoon.

The location of these lagoons were north of the manufacturing building (Figure 2). This area slopes to the railroad approximately 200 feet north. The railroad cut is a minimum 45 feet below the surface elevation of the lagoon areas.

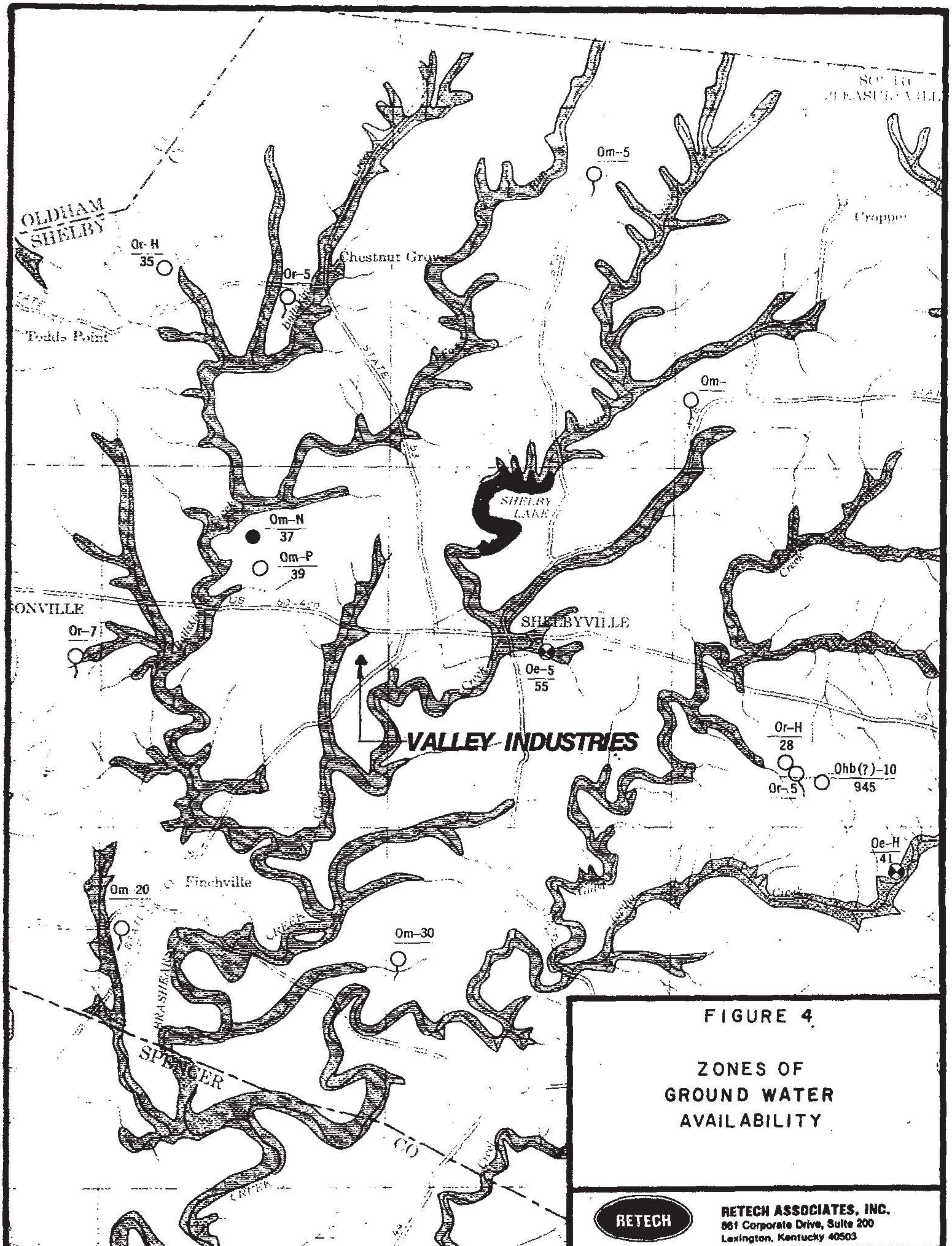
The waste from the lake and possibly waste from Lagoon #2 and #3 is located west of the manufacturing (Figure 2). Soil material in this area is mounded to a high of 2.5 to 3 feet above grade. This area is essentially on the ridge top which is flat. Apparently this area received fill when the building was constructed.

Geology of the site is partly exposed at the railroad cut. As much as 20 feet is exposed in some areas. Due to the age of the cut, geologic characteristics of the cut are not distinguishable. It is composed of limestone, shale and claystone.

Data on site soil thickness is evident at the railroad cut and also from borehole data. On the hill side the soil is 3 to 4 feet thick over Lagoon Areas # 1 and #3 and 5 to 6 feet thick over Lagoon Area #2. The soil thickness at the railroad is much thinner and ranges from 2 to 3 feet thick. This would be expected due to erosion. The soil is a brown silty clay with very low permability. Four shelby tube samples were collected in the lagoon area and their permability averaged 10 or less.

Ground water seeps from the rock formation were not evident at the site. This supports the regional assessment of ground water which indicated the steep hill sides are essentially void of ground water.

Surface water drainage from the lagoon area is toward the railroad in a northeasterly direction. Drainage from the waste area is northwesterly towards to the railroad. A ditch along the railroad


OLDHAM
SHELBY
Or-H 35
Or-5
Chestnut Grove
Todds Point
Om-5
Om-
Croppe
Om-N 37
Om-P 39
SHELBY LAKE
ONVILLE
Or-7
SHELBYVILLE
Oe-5 55
VALLEY INDUSTRIES
Or-H 28
Or-5
Ohb(?)-10 945
Oe-H 41
Om-20
Finchville
Om-30
BRASHEARS
SPENCER
CO
CREEK
Creek
FIGURE 4
ZONES OF GROUND WATER AVAILABILITY
RETECH
RETECH ASSOCIATES, INC.
861 Corporate Drive, Suite 200
Lexington, Kentucky 40503

conveys water due east or west. A line due north of the northwest corner of the building is the divide line for flow direction. Flow is barely detectable in this ditch. The emergency overflow from the lake will flow to the ditch and then due east.

SITE INVESTIGATIONS

Site investigations were conducted to determine the location and status of the waste lagoons which received chromium electroplating waste. A combination of aerial photography and discussions with plant personnel were used to locate the three areas.

The source of data used to locate the three lagoon areas varied. Aerial photography taken for Kentucky Department of Transportation on May 10, 1975 showed location of Lagoon #1. Aerial photography taken by Park Aerial Survey's, Inc. dated April 9, 1976 showed location of Lagoon #2. Historical aerial photography was not available to locate Lagoon #3. Plant personnel, however, have been able to accurately locate all three lagoons. Since Lagoon #3 was the last area used recall of the plant personnel should be accurate.

A sampling program was conducted to determine present levels of contamination in the lagoons, area that received waste from the lake, and adjacent surface water (Figure 2). Subsurface soil samples were collected from the lagoon areas at various intervals to bedrock with split spoon and a soil probe. The soil probe was used to collect 5 samples from the waste area at depths 0.5 to 1.5 feet. Grab samples were collected of the surface water that receives both ground water and surface runoff from the waste areas and lagoon areas.

Two sample preparation methods were used on the soil samples prior to analysis. One method was total digestion per Standard Methods (1980). The other method was a milder acetic acid leach using the EP toxicity method, according to U.S.EPA, "Test Methods for Evaluating Solid Waste", SW646, 1980.

The result of soil analysis using the total digestion sample preparation method for the three lagoon areas are presented for each heavy metal in Figures 5, 6, 7 and 8. These results confirm the visual inspection of the samples which indicated a waste material was not present in Lagoon Area #3. Visual inspection indicated that a waste material was present in Lagoon Area #1 at a depth of 4 feet below

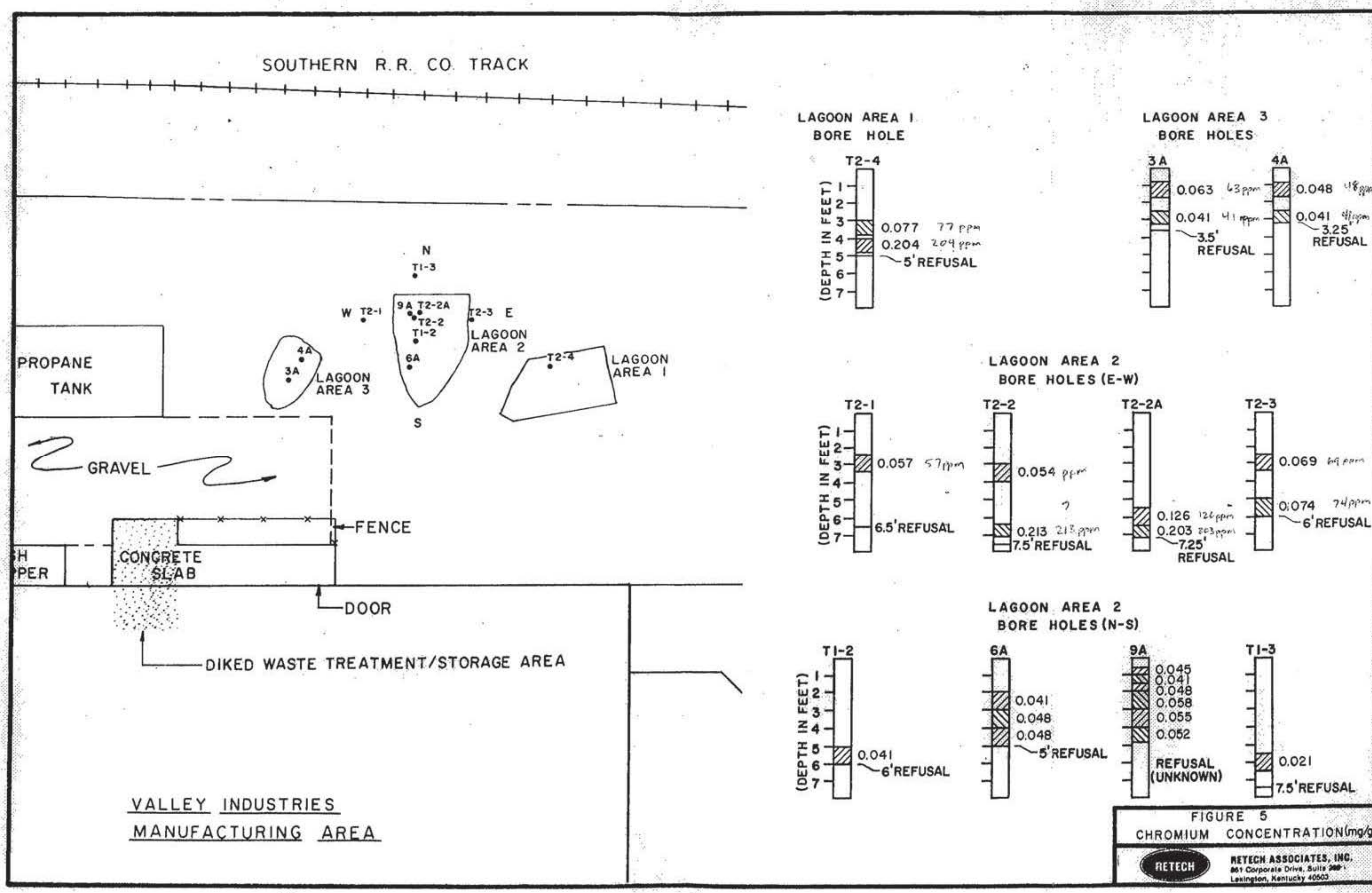


FIGURE 5
CHROMIUM CONCENTRATION(mg/g)

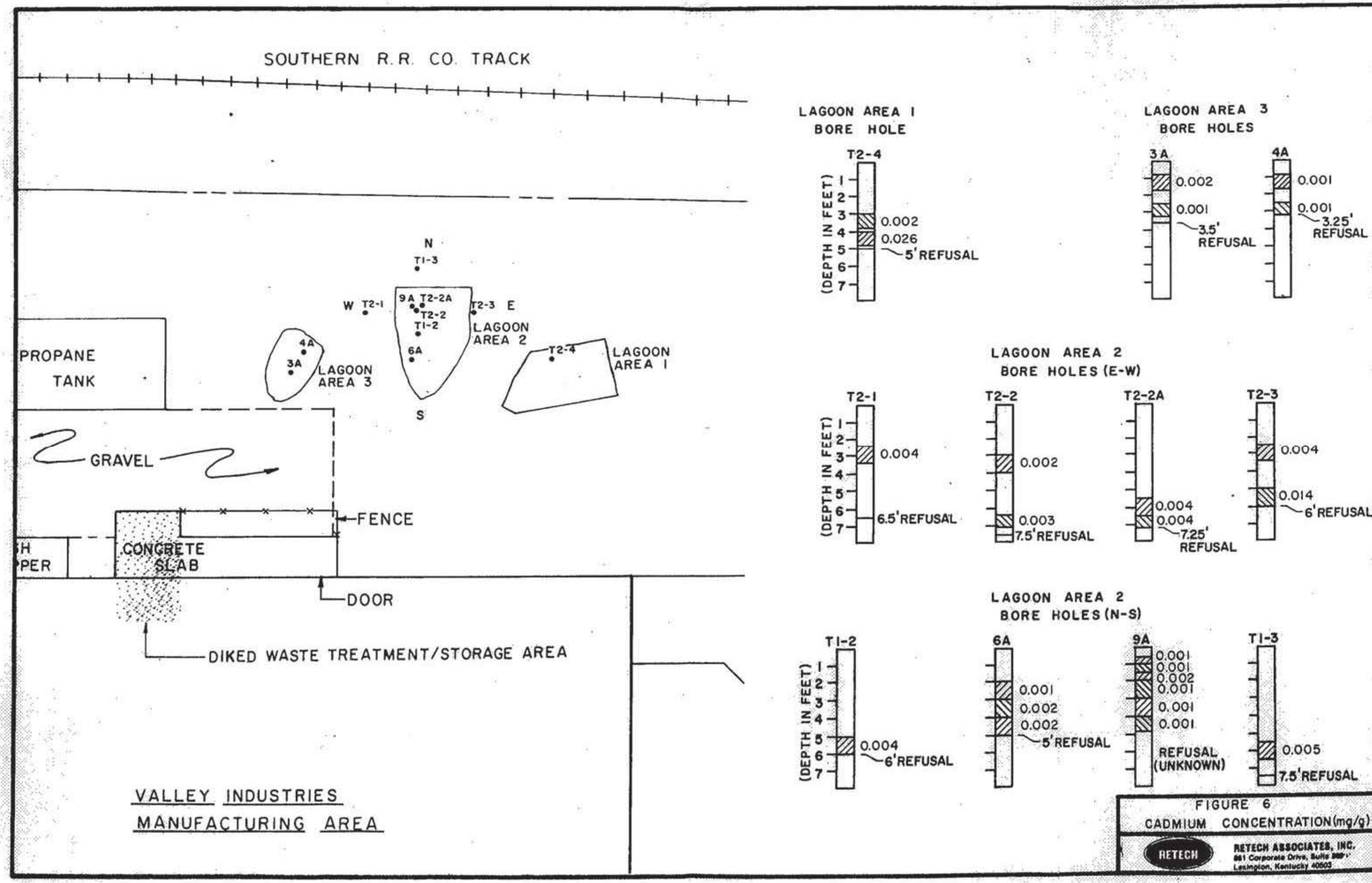


FIGURE 6
CADMIUM CONCENTRATION (mg/g)

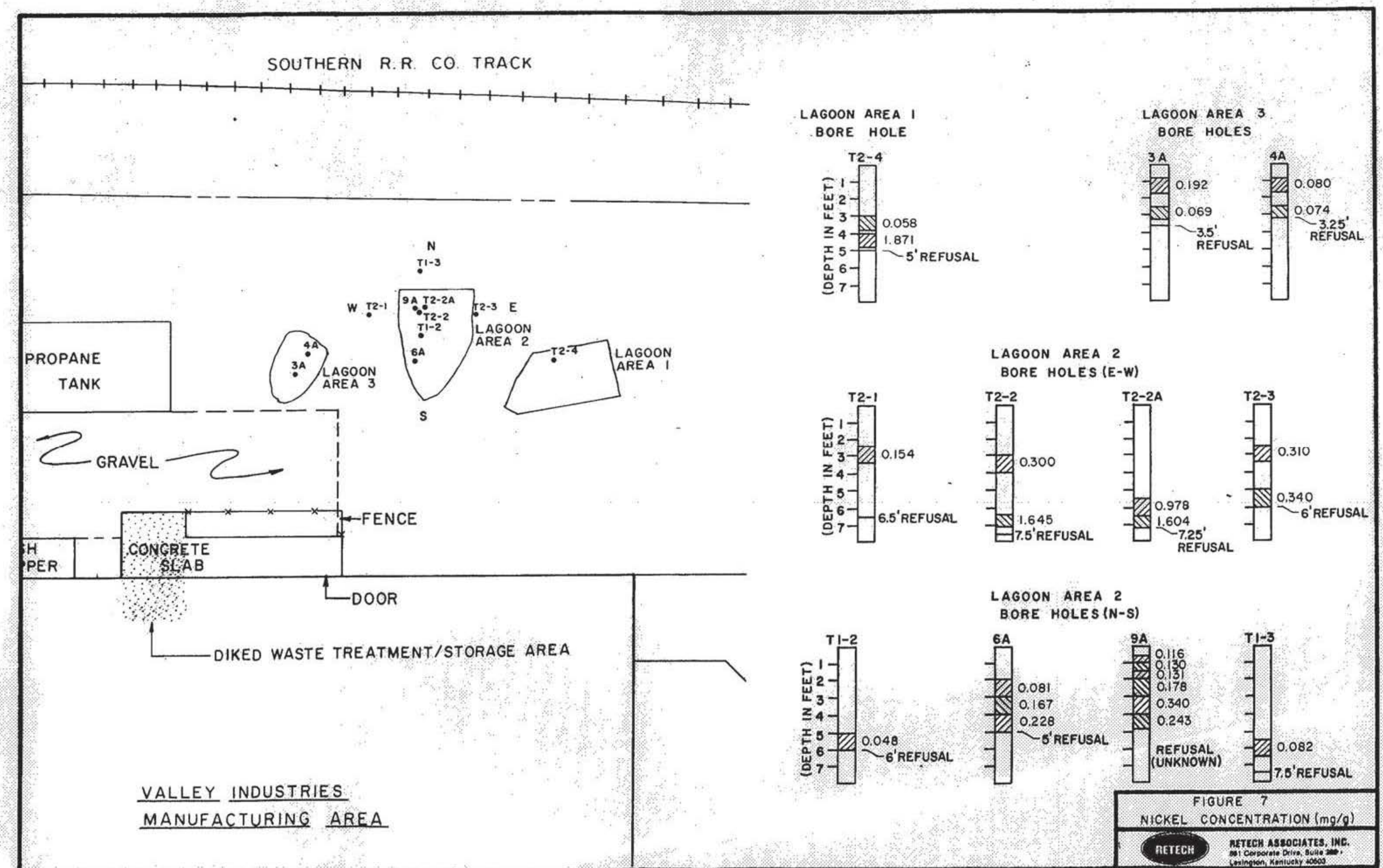


FIGURE 7
NICKEL CONCENTRATION (mg/g)

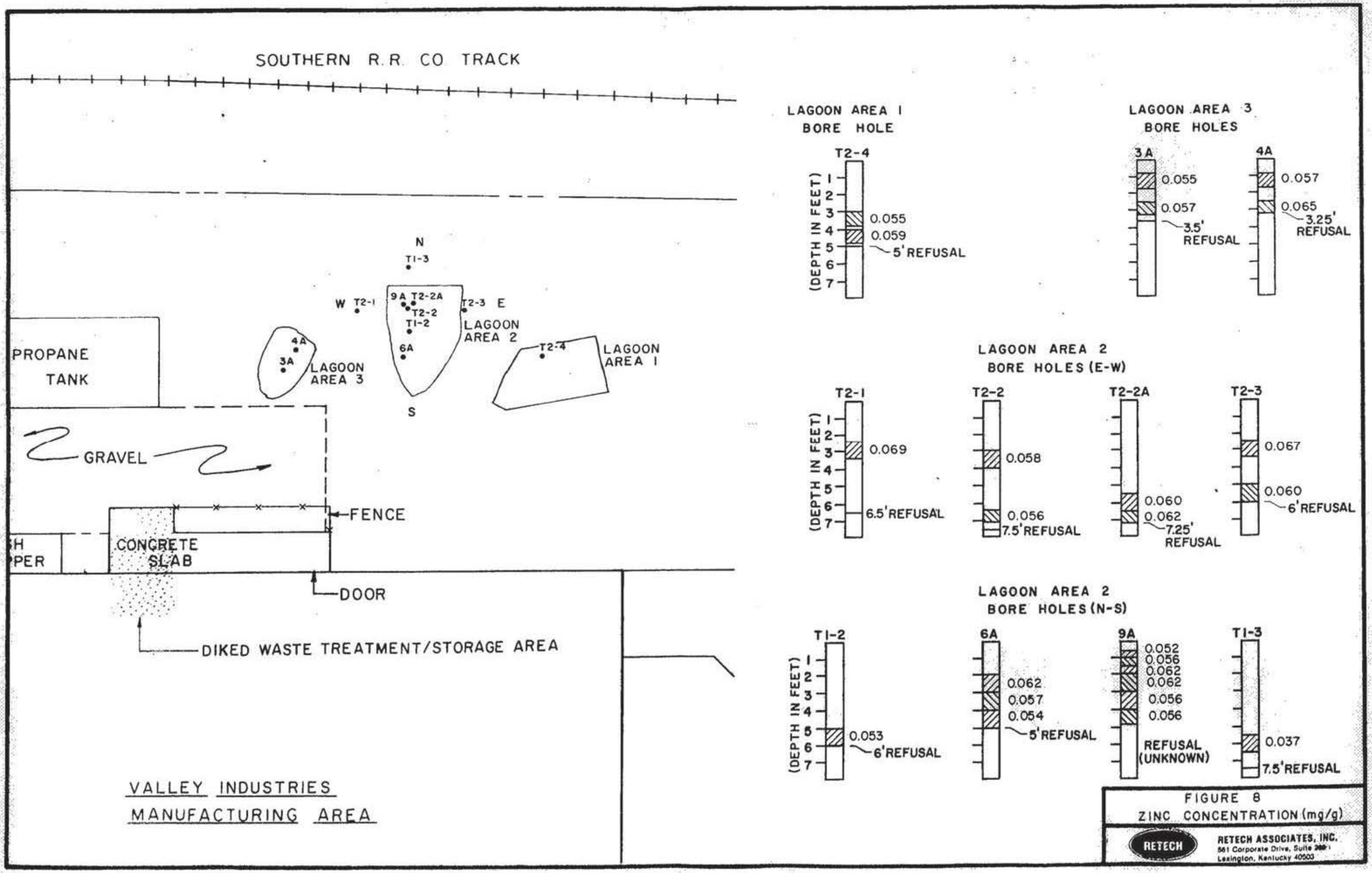


FIGURE 8
ZINC CONCENTRATION (mg/g)

grade. The waste material was about 10 inches thick in bore hole T2-4. Lagoon Area #2 also had a waste residue present. It was observed at about 6.5 feet below grade in both T2-2 and T2-2A and was 6 to 9 inches thick. A metal object was encountered at 5 feet below grade (extent of drilling with powered hand auger) in bore hole 9A which indicates waste was present.

In addition to heavy metal analyses the waste residue was analyzed for total cyanide. The low levels observed confirm that cyanide was not used in the electroplating process. Results are listed below:

TOTAL CYANIDE RESULTS
(ppm on a dry weight basis)

Sample	Cyanide
Lagoon Area #1	0.18
Lagoon Area #2	0.29
Lagoon Area #3	0.29

Quantity of waste residue that remains in Lagoon Area #1 and #2 is quite small. Assuming that waste in Lagoon Area #1 is 25 feet by 30 feet and the waste is to a depth of 9 inches, residue is on the order of 20 cubic yards. Similarly Lagoon Area #2 contains waste in an area 20 by 25 to a depth of 9 inches would equal about 14 cubic yards of residue.

Analysis of the waste residue in Lagoon Area #1 and Lagoon Area #2 shows this material has a relatively low level of heavy metals. Listed below are the factors for increase above background levels. Where were background samples taken?

INCREASE ABOVE BACKGROUND LEVELS

	Lagoon Area #1	Lagoon Area #2
Chromium	4.5 to 5 times	4.5 to 5 times
Cadmium	13 times	1.5 to 2 times
Nickel	30 times	27 times
Zinc	1 time	1 time

Leachability of the metals in the waste from Lagoon Area #1 and #2 is also rather low. It varies significantly with each metal. Table 1 presents a comparison of total metals to metals from the leach method (EP Toxicity) on a dry weight basis. Also, the EP Toxicity results are well below the standards for maximum allowable concentrations (Table 2). In fact, levels in Lagoon Area #1 are 26 percent or less of the standards. In Lagoon Area #2 levels are less than 10 percent of the standards.

Similar analyses were performed on samples from the waste area which contains about 500 cubic yards of material (25 yds by 30 yds by 0.67 yds). Concentrations of total metals in mg per gram of total dry weight are listed in Table 3. These levels are below standards used to determine acceptability of sewage sludge for application to agricultural lands.

— To this

TABLE 1 Lagoon Area Waste Leachability
(Concentrations in mg per gram dry weight)

Samples	Parameters			
	Cadmium	Chromium	Nickel	Zinc
Lagoon Area #1				
Total Metals	0.026	0.204	1.871	0.059
Leached Metals	0.0004	0.0008	0.105	0.0008
Lagoon Area #2				
Total Metals	0.004	0.126	0.978	0.060
Leached Metals	0.0014	0.001	0.018	0.0026
Lagoon Area #2				
Total Metals	0.004	0.203	1.604	0.062
Leached Metals	0.0014	0.0008	0.024	0.0024

2) Station T2-2A @ 6 foot depth

3) Station T2-2A bottom sample, 6.75 to 7.25 feet deep

TABLE 2 Lagoon Area EP Toxicity Results

Samples	Cadmium Concentration mg/L	Cadmium Percent of Standard	Chromium Concentration mg/L	Chromium Percent of Standard	Nickel Concentration mg/L	Nickel Percent of Standard	Zinc Concentration mg/L
Lagoon Area #1	0.02	2.0	0.04	0.80	5.26	26.3	0.04
Lagoon Area #2	0.07	7.0	0.05	1.0	0.88	4.4	0.13
Lagoon Area #2	0.07	7.0	0.04	0.8	1.18	5.9	0.12
Standard (Maximum Allowable Concentration)	1.0	-	5.0	-	20.00	-	N/A

TABLE 3 Waste Area Total Metal Concentrations

(Concentration in mg per gram dry weight)

Samples	Cadmium	Chromium	Nickel	Zinc
Station 1	0.003	0.731	5.02	0.066
Station 2	0.002	0.302	2.17	0.069
Station 3	0.003	0.386	2.53	0.065
Station 4	0.002	0.587	4.04	0.065
Station 5	0.003	0.407	2.95	0.074

Both total digestion and acetic acid leach were performed on sample from station #3 in the waste area. Although levels of chromium and nickel were high in this waste sample when compared to the Lagoon Areas #1 and #2, leachability was still low. A comparison of total metals to metals from the leach on a weight basis is listed below:

LEACHABILITY RESULTS FOR THE WASTE AREA
(Concentrations in mg per gram dry weight)

	Cadmium	Chromium	Nickel	Zinc
Station #3				
Total Metals	0.0030	0.3860	2.530	0.0650
Leached Metals	0.0026	0.0055	0.344	0.0078

Since two sets of analysis were performed on one sample, these data can be used to estimate EP toxicity of samples analyzed for total metals from the other stations in the waste area. This waste material is essential homogeneous in texture and concentrations of total metals are similar. Therefore, it seems reasonable that they would leach under the EP toxicity test in a similar ratio. The actual test results from station #3 and the estimated EP toxicity data are presented in Table 4.

As the data indicates this waste material has extremely low leachability. All the results are 10 percent or less of the allowable maximum contaminant level.

TABLE 4 WASTE AREA EP Toxicity Results

Samples	Parameters						
	Cadmium		Chromium		Nickel		Zinc
	Concentration mg/L	Percent of Standard	Concentration mg/L	Percent of Standard	Concentration mg/L	Percent of Standard	Concentration mg/L
Station #1	0.07	7.0	0.51	10.2	0.77	3.8	17.5
Station #2	0.05	5.0	0.21	4.2	0.33	1.6	18.3
Station #3	0.07	7.0	0.27	5.4	0.39	2.0	17.2
Station #4	0.05	5.0	0.41	8.2	0.62	3.1	17.2
Station #5	0.07	7.0	0.28	5.6	0.45	2.2	19.6
Standard (Maximum Allowable Concentration)	1.0	-	5.0	-	20.0	-	N/A

ENVIRONMENT ASSESSMENT

As indicated by test results both the waste in the two lagoon areas and in the waste area is relatively low in heavy metals. All waste material has low leachability and is well below the EP Toxicity standards. *In fact, residue in the waste area contain metals* concentrations below standards established for application of sewage treatment sludge to agricultural lands. Therefore, it is reasonable to assume that no enviromental hazard exist at the site.

Several additional factors limit movement of waste contaminants offsite.

1) Low permability and thickness of the cap and side material. (Permability less than 10^{-7} cm/sec and cap 4 to 6 feet thick)
2) Lowest level of the waste is above ground water levels.

In order to support these assessments surface water adjacent to the site (Figure 2) was sampled and tested for heavy metal to assess degree of contamination. This water receives surface runoff from the waste areas and also any ground water seepage from the waste area. The results *of these analyses are presented* in Table 5. Data on water quality of the lake is also presented. These waters meet the standards for both public water supply and fish and wildlife. Therefore, it can be assumed that the waste area and lagoon areas are not causing excessive environmental degradation.

TABLE 5 Surface Water Analyses,
March 25, 1983

PARAMETER	Station #1 (Ditch)	Station #2 (Ditch)	Station #3 (Ditch)	Station #4 (Lake)
pH	8.4	8.5	8.0	7.3
Specific conductance (uhmos/cm)	684	861	810	269
Cadmium (mg/L)	0.01	0.01	0.01	0.01
Chromium, hexavalent (mg/L)	0.01	0.01	0.01	0.01
Nickel (mg/L)	0.01	0.03	0.04	0.10
Zinc (mg/L)	0.02	0.02	0.02	0.27

References

APHA, AWWA and WPCF. 1980. "Standard Methods for the Examination of Water and Wastewater, Fifteenth Edition". American Public Health Association.

Hall, F.R. and W.N. Palmquist, Jr. 1960. "Availability of Ground Water in Anderson, Franklin, Shelby, Spencer and Woodford Counties, Kentucky." U.S. Geological Survey.

Peterson, Warren L. 1978. "Geologic Map of the Simpsonville Quadrangle, Shelby and Spencer Counties, Kentucky". U.S. Geological Survey.

U.S. EPA. 1980. "Test Methods for Evaluating Solid Waste." SW-646, U.S. EPA.

Reference 13

ADMINISTRATIVE RECORDS FOR TERMINATION

OF INTERIM STATUS HAZARDOUS WASTE FACILITY

VALLEY INDUSTRIES

KYD062985999

PUBLIC NOTICE

NOTICE OF INTENT TO TERMINATE INTERIM STATUS UNDER KENTUCKY REVISED STATUTES CHAPTER 224

February 17, 1984

The Kentucky Natural Resources and Environmental Protection Cabinet proposes to terminate the interim status as a hazardous waste facility to Valley Industries located at McDaniel Road, Shelbyville, Kentucky 40065, under the authority of Kentucky Revised Statutes (KRS) Chapter 224. The facility has been assigned EPA Identification No. KYD062985999.

The facility had been conducting hazardous waste activities under interim status granted by Title 401, Chapter 38 of the Kentucky Administrative regulations until May 27, 1983, when the facility closed under an approved closure plan. The company decided to discontinue hazardous waste activities at this facility and not seek a hazardous waste permit by closing the facility

This is to notify the interested public that written comments on this tentative decision and requests for a public hearing should be received by the Department on or before April 2, 1984.

Persons wishing to comment on or object to this decision should submit such comments in writing. In addition, any person who may be aggrieved by the termination of interim status for this waste management site (on site storage) may file with the Cabinet a petition which sets forth grounds of the objection and demand a hearing pursuant to KRS 224.081(2) on or before April 2, 1984. Comments and petition should be sent to the Kentucky Department for Environmental Protection, Division of Waste Management, Fort Boone Plaza, Building No. 2, 18 Reilly Road, Frankfort, Kentucky 40601, Attn: Ms. Caroline Patrick Haight.

If significant public interest is expressed in holding a hearing, then the Department will hold a hearing and a public notice scheduling the date and time of the hearing will be given at least 30 days before the hearing. The decision by the Cabinet as to whether there is a significant public interest in holding a hearing will be based on the receipt of at least one written notice of opposition and a request for public hearing by April 2, 1984. All written comments received on or before the above mentioned date will be considered by the Cabinet in formulating a decision, regardless of whether a hearing is held. After consideration of all written comments and requirements of Kentucky Revised Statutes and appropriate regulations, the Secretary of Natural Resources and Environmental Protection Cabinet will make her decision regarding the termination of interim status. If determinations are substantially unchanged from those announced by this notice, the Secretary will so notify all persons submitting written comments. If the determinations are substantially changed, the Secretary will issue a public notice indicating the revised determination.

The administrative record for this permit decision consists of the Part A permit application, the notice of intent to terminate interim status, fact sheet and related correspondence. The administrative record and related information may be reviewed and/or copied at the Division of Waste Management office between the hours of 8:15 a.m. and 4:30 p.m., Monday through Friday. Copying charges are 25 cents per page. Administrative records, comments received and additional information on the hearing procedure are also available by writing the Division of Waste Management at the above address and sending the copying charges. An additional copy of the administrative record and related correspondence will also be available for review at Shelby County Public Library, 309 Eighth Street, Shelbyville, Kentucky, during library hours.

30 SECOND RADIO ANNOUNCEMENT

The Kentucky Natural Resources and Environmental Protection Cabinet has accepted the closure of hazardous waste facility at Valley Industries, McDaniel Road, Shelbyville, Kentucky 40065, and proposes to terminate the interim status of this facility under Kentucky Revised Statutes.

Information regarding this proposed decision may be reviewed at the Division of Waste Management, 18 Reilly Road, Frankfort, Kentucky, and at Shelby County Public Library, 309 Eighth Street, Shelbyville, Kentucky 40065 before April 2, 1984. If you feel that a public hearing should be held or if you wish to make any comments on the proposal, contact Ms. Haight at (502) 564-6716, ext. 272, by April 2, 1984.

FACT SHEET

Intent to Terminate Interim Status Under KRS 224

Activity:	Hazardous Waste Storage
Facility Name:	Valley Industries
EPA I.D. No.:	KYD062985999
Location:	McDaniel Road, Shelbyville, Kentucky 40065
Facility Owner:	The Scott & Fetzer Company
Facility Operator:	Valley Industries Division of Scott & Fetzer Company

Background and Reasons for Decision to Terminate Interim Status

Valley Industries qualified as an interim status storage facility having been in existance on November 19, 1980, and filed the required notification and Part A of the application on time. On November 19, 1980, EPA Region IV and the Kentucky Division of Waste Management formally requested Valley Industries to submit part B of their permit application. As required under the hazardous waste regulations, they were given six months time to prepare and submit the Part B of the application and a due date of May 21, 1983 was established. However, before the due date of the submittal, the facility requested to close the facility and was approved to do so on February 17, 1983. Since the facility decided not to continue the permitted activity under interim status and declined to seek a permit for storing hazardous waste (by closing the facility in lieu of submitting Part B of the application), the Cabinet has decided to terminate the facility's interim status.

The decision of the Cabinet is based on the fact that the facility does not intend to continue the hazardous waste activities requiring interim status or a hazardous waste permit at present.

Closure of the Facility

If this tentative decision becomes the final administrative disposition of the permit application, interim status will be terminated. However, since the facility was closed on May 27, 1983, according to the approved closure plan and certified as such, the requirements of 401 KAR 35:070 Section 3(3)a regarding submittal of closure plan has been met.

Comment Period

Begins:	February 17, 1984
Ends:	April 2, 1984

All persons, including the owner/operator of the facility, who believe that the tentative decision to terminate interim status of this facility is inappropriate, must raise all ascertainable issues and submit all available arguments and factual grounds supporting their position by April 2, 1984. Comments should be sent to Ms. Caroline P. Haight, Division of Waste Management, 18 Reilly Road, Frankfort, Kentucky 40601.

Procedures for Requesting a Hearing

If significant public interest is expressed in holding a hearing, then the Department will hold a hearing. The place, date and time of hearing will be notified later by giving a public notice when determination to hold a hearing is made. The decision by the Cabinet as to whether there is significant public interest in holding a hearing, will be based on the receipt of at least one written notice of opposition and a request for hearing by April 2, 1984. Any request for hearing shall be in writing and state the nature of the issues proposed to be raised in the hearing. Requests for a hearing should be submitted to Ms. Caroline P. Haight, Division of Waste Management, 18 Reilly Road, Frankfort, Kentucky 40601.

October 28, 1983

Mr. Gary Craig, Manager
Valley Industries
McDaniel Road
Shelbyville, Kentucky 40065

Re: Termination of Interim Status
EPA I.D. #KYD062985999

Dear Mr. Craig:

As an interim status facility, on November 22, 1982, you were requested to submit the Part B of the hazardous waste facility permit application jointly by EPA Region IV and the Kentucky Division of Waste Management. Our records show that prior to the scheduled date of Part B application submittal, you had decided to discontinue the hazardous waste activity requiring a permit by closing the facility. Your facility has since been closed on May 27, 1983, and certified as such.

In view of your aforementioned decision to discontinue the interim status activity and not to seek a hazardous waste permit (by closing the facility in lieu of submitting a Part B application) the Cabinet has decided to terminate the interim status according to procedures of 401 KAR Chapter 38 (permit regulations). This will be the final permit action on your facility and will involve publication of notice of intent to terminate interim status and request for hearing, preparation of fact sheet, etc.

The Cabinet will be initiating these procedures shortly and you will be notified at that time.

If you have any further questions, please feel free to contact Ms. Caroline P. Haight at (502) 564-6716, ext. 272.

Sincerely,

J. Alex Barber

J. Alex Barber, Director
Division of Waste Management

JAB:MA:akw

cc: EPA - Region V
Mohammad Alauddin
Louisville Field Office

82-053

RECEIVED

JUN 2 0 1983

DIVISION OF
WASTE MANAGEMENT

M E M O R A N D U M

TO: George Gilbert, Envir. Engineer GEG
Plans Review Section

VIA: Carl Schroeder, Manager CAS
Field Operations Branch

John Brooks, Envir. Supervisor JB.
Louisville Office

FROM: Carl Horneman, Envir. Inspector Sr. HcH
Louisville Office

DATE: June 16, 1983

SUBJECT: Field verification of storage facility closure for Valley Industries.

As you are aware, Valley Industries in Shelbyville, Kentucky recently closed its storage facility. On June 7, 1983 Valley Industries submitted its certificate of closure in a meeting at the Frankfort Office.

All hazardous waste generated at this plant consisted of wastewater type waste treated at the plant prior to discharge to a publicly owned treatment works. Treatment of these wastewaters resulted in a production of a dry-cake sludge. Since some of the wastewaters treated at the plant were electroplating waste, the sludge has been classified as a listed hazardous waste with an EPA I.D. #F006. That sludge is the only hazardous waste generated at this facility that has been stored in a manner requiring a hazardous waste storage permit. The storage facility has been closed due to the fact that electroplating operations causing the sludge to become a listed waste have been removed from the plant.

The wastewater treatment sludge had been stored in a 20 cubic yard roll-on, roll-off type waste box. A canvas cover with waterproofing has been used to prevent infiltration of surface water and rainwater into the waste during storage. This storage container was placed on a concrete pad with diked sides that drained to a sump. Any rainwater falling on the storage pad was immediately removed from this sump and treated as wastewater generated in the plant.

Closure of the storage facility had been completed in the following manner:

1) All electroplating operations involving chrome and nickel were taken out of operation. The electroplating wastes, rinses and baths were all treated prior to discharge to the POTW.

2) All electroplating equipment was thoroughly cleaned with strong acid and water rinses.

3) All drainage from the electroplating operation and from the storage area were cleaned with strong acid rinses and water. The storage pad was further cleaned with a steam-jenny.

4) All cleaning rinses were either treated on-site prior to discharge to the POTW or placed in storage tanks and picked up by a disposal company.

5) The storage container containing the treatment sludge and all untreated cleanup rinses were collected by I.L.W.D. from Indianapolis, Indiana. That waste was shipped with proper manifests to the I.L.W.D. plant for further treatment and disposal.

6) Soil samples of the soil around the storage area were taken to demonstrate lack of contamination. The results of those analyses have been provided in the certificate of closure.

It appeared from my inspection that all of the above activities had been completed. I, therefore, recommend that this site be considered a closed facility.

HCH:dm

File Copy

June 13, 1983

Mr. Gary Craig, Manager
Valley Industries
McDaniel Road
Shelbyville, Kentucky 40065

RE: Application #83-053, Certification of Closure Plan for Hazardous Waste Facility EPA I.D. #KYD06-298-5999

Dear Mr. Craig:

The Division of Waste Management has received your letter and associated documentation dated May 27, 1983. Mr. William F. Grier, P.E., Ky. #7822, Mr. Gerald Sebree, and yourself certify closure of the electroplating waste container storage area and treatment process. The closure was made in accordance with the previously approved plan except for denoted completion date extension. The correspondence is accepted under the provisions of 40 CFR 265.115 "Certification of Closure" which is incorporated by reference in 401 KAR 35:010 (formerly 401 KAR 2:073) Section 6. Valley Industries in Shelbyville will not treat, store, or dispose of hazardous waste in the future unless a new permit application is made pursuant to KRS Chapter 224.

The Commonwealth of Kentucky is requesting by a copy of this letter that U.S. EPA Region IV remove your Part "A" Hazardous Waste Facility Permit Application from the active file. The Kentucky Division of Waste Management is also removing your name from the list of hazarodus waste generators. The last annual "Hazardous Waste Report" should be filed by March 1, 1983 per 401 KAR 35:010 Section Y and 40 CFR 265.75. A representative from the Louisville Field Office will check all hazardous waste manifests during the next scheduled visit.

If you have any questions on certification of closure, please contact Mr. George F. Gilbert, Jr., P.E., of the Hazardous Waste Plans Review Section at (502) 564-6716, Ext. 237 or Mr. John Brooks of the Louisville Field Office at (502) 588-4254.

Sincerely,

J. Alex Barber

J. Alex Barber, Director
Division of Waste Management

JAB:GFG:cg

cc: John Brooks, Area Supervisor
William F. Grier, Retech Associates, Inc.
Gerald Sebree, Shelby Industries
James Scarbrough, U.S. EPA Region IV

RETECH

A Resource Technology Company
Consultants in the Environmental & Resource Sciences

CERTIFICATION OF CLOSURE
Hazardous Waste Facility
No. KYD06-298-5999
Closure Plan
No. 82-53

for

Valley Industries
Shelbyville Facility

RECEIVED
JUN 07 1983
DIVISION OF
WASTE MANAGEMENT

May 31, 1983

RETECH ASSOCIATES, INC.
861 Corporate Drive, Suite 200
Lexington, Kentucky 40503
(606) 223-2901

Valley Industries

Eastern Plant
McDaniel Road
Shelbyville, KY 40065
Telephone (502) 633-2040

May 27, 1983

Ms. Caroline Patrick Haight
Division of Waste Management
18 Reilly Road
Frankfort, Kentucky 40601

RE: Closure Certification Closure Plan
No. #82-53

Dear Ms. Haight:

This letter transmits the Closure Certification for Valley Industries Hazardous Waste Facility No. KYD06-298-5999. Also included with the Closure Certification are the following items:

1) Printed public notice and affidavit of publication
2) Soil Analysis Report
3) Closure Cost
4) Deviations from the closure plan (included in the Closure Certification)
5) Letter approving the closure plan
6) Letter approving the soil analysis report

It is our understanding that closure is now complete. If you have additional questions, please advise. Thank you for your cooperation and assistance in closure of our hazardous waste facility.

Sincerely,

Gary L. Craig

Mr. Gary Craig

cc: George F. Gilbert, Divison of Waste Management

CLOSURE CERTIFICATION

CLOSURE CERTIFICATION
Hazardous Waste Facility
Valley Industries, Inc.
No. KYDO6-298-5999

BACKGROUND

Valley Industries submitted a closure plan (#82-53) for a hazardous waste storage facility at their plant site in Shelby County, Kentucky to Kentucky Department for Environmental Protection Division of Waste Management.

An attached public notice was published in a newspaper of general circulation in Shelbyville, Kentucky and the thirty day comment period has elapsed with no comments.

The Division of Waste Management has approved the closure plan with the submittal of the following information:

1) Analysis for cadmium in soil samples from areas with potential for contamination,
2) Estimate of the amount of decontamination residues, if any,
3) Actual costs of closure,
4) Deviations from the closure plan, if any, and
5) Signatures by an independent P.E. and authorized official of the company.

The enclosed soil analysis report addresses items #1 and #2. The areas of potential soil contamination and sampling locations are identified. The analyses of 9 samples for cadmium, chromium and nickel are compared to maximum concentration of contaminants of Extration Procedure (EP) toxicity. The levels of these metals is only 0.01% to 3.0% of the allowable level, hence, no residues are present which must undergo decontamination. (note attached letter from Caroline Patrick Haight dated May 19, 1983)

Data on actual closure cost (item #3) are attached hereto. This attachment also contains a description of the activities related to these costs. Total closure costs are ~~$12,050.~~ $15,700

The only deviation from the closure plan (item #4) was the schedule of final closure. An extension of closure from May 1, 1983 to May 31, 1983 was requested as a result of weather related delays. This extension was approved by the Division of Waste Management.

The revised closure schedule dates are:

1) Dates for completion of inventory disposal:
   a. Date all preprocessing completed - May 20, 1983
   b. Date all inventory has been removed offsite - May 31, 1983
2) Final date facility decontaminated - May 27, 1983
3) Final date closure completed ~~-May 31~~, 1983 June 30, WAS

CERTIFICATION

Pursuant to 401 KAR 2:073 Section 6 and 40 CFR 265 Subpart G the undersigned independent Professional Engineer and authorized officials certify the Hazardous Waste Facility #KYD06-298-5999 is closed in accordance with the Closure Plan #82-53 with deviations as stated in this "Closure Certification". William F. Grier, an independent P.E. has inspected all process and pretreatment equipment and has confirmed such equipment is free of waste residues. Mr. Grier also was present when the concrete pad waste storage facility was steam cleaned as specified in the closure plan. Mr. Grier certifies that the decontamination procedures outlined in the Closure Plan #82-53 were followed. Similarly Mr. Gerald Sebree and Mr. Gary Craig certify that the storage facility was decontaminated and all waste and residues were removed offsite to an approved landfill.

6-3-83

Gary Craig, ~~Vice President~~ Warehouse Manager Jr. Date

Valley Industries

6/3/83

Gerald Sebree, Vice President Date

Shelby Industries

6/3/83

William F. Grier, P.E. Date

PUBLIC NOTICE

AND

AFFIDAVIT OF PUBLICATION

A F F I D A V I T

Proof of Publication

I, Judy James, do hereby certify that I hold the position of Classifieds Mgr with The Sentinel-News in Shelbyville, Kentucky, and in such position have the responsibility of publication of Legal Notices in said newspaper and that the attached Legal Notice has been published in all edition of said newspaper April 21, 25, 28 and May 2, 5, 9, 12, 18, 20.

Judy James

Subscribed and sworn before me in my presence this the 25 day of May, 1983.

[illegible]
Notary Public

My commission expires the 13 day of July, 1986.

The Sentinel-News

CLASSIFIEDS

10 REAL ESTATE

HOUSE FOR SALE. 2 bedroom, full basement, carpet, storm windows and doors, drapes, appliances, Shelbyville. By owner $29,900. Phone 633-0067.

LOT FOR SALE by owner. Arlington Subdivision on back row, Shelbyville, Ky., $9,950. John Stacey 502-583-4417 or 502-425-2416.

Magnolia 808
Trade anything of real value you have. Livestock, groceries, frozen food, car, mobile home, horses, real estate for down payment. Appraised $54,000, loan available of $48,600 or $43,000. Also rent or contract for deed. For cash, May 2nd. possession. Tom Helm. 1 (502) 423-1331 office, (502) 895-9283 home.

11 RENTAL

3 ROOM APT., partially furnished. Call 633-3128.

ATTRACTIVE one bedroom apartment in historic bank building. Convenient to Frankfort or Shelbyville. Water included, $200 month. 1-695-5697 or 1-223-0089.

FREE RENT. Will exchange trailer rent for light duties on farm. Prefer responsible male. Will consider couple. References required. 829-5984.

FURNISHED sleeping room with private bath for Single adult only. 633-5609.

HOUSE AND GARDEN in country on Highway 1005, east of Bagdad. Must have best of references, prefer middle-aged ... 747-8404

13 CARDS OF THANKS

In Loving Memories
of Alma Rice

Our dearest Mom, in Heaven above, We're writing this to send our love.

To tell you, how much you're missed each day, in this year since you've gone away.

When the doctor told you, that you were dying and tears filled your beautiful eyes.

You kept a quiet comport and looked up at the sky as your hands trembled at your side.

Clayton and I knew what you were thinking, but we kept very quiet.

We knew in time you'd tell us what to do at the end of your life.

You left your sons and daughters, their husbands and their wives, your grandchildren, your sisters.

And your devoted Ambrose, who was so good to you.

You gave up your fight to live and chose to go to a better life, free of worry and pain.

You held your hand out to God, who came and took you to the Promised Land.

As we sat with tears in our eyes, our hearts were broken so inside.

To this day we can see your saddened face.

We wake up each morning thinking of you and pray for you each night.

We thank God for the years we had together, and for you making them so bright.

For all the love you gave us and making us understand.

That someday, we will all be together in a better land.

So always know, dear Mother how we miss you so.

We love you so very much

15 LEGAL NOTICE

Public Notice

Valley Industries of McDaniel Road, Shelbyville, Kentucky 40065 has submitted a plan to the Kentucky Natural Resources and Environmental Protection Cabinet to close the hazardous waste storage facility located at their plant site. Hazardous waste will no longer be stored at the site if the plan is approved by the Cabinet. Any person who may be aggrieved by the closure of this existing hazardous waste facility may file with the Cabinet within thirty (30) days written comments setting forth the grounds of the objection as allowed by 401 KAR 2:073 Section 6 and 40 CFR 265.112(d) or a petition stating objections and demanding a hearing pursuant to KRS 224.081. The written comments or petition may be mailed to: Director, Division of Waste Management, 18 Reilly Road, Frankfort, Kentucky 40601. The existing hazardous waste facility uses bulk containers to store sludge generated from electroplating operations. The plant is changing its manufacturing process so that only non-hazardous sludge will be generated. The firm has only stored its own waste to date and has not accepted wastes from outside sources. If the plan is approved, no more hazardous wastes will be stored at the Valley Industries Site.

Notice

I will not be responsible for

15 LEGAL NOT

Public Notice

The Central Kentucky ...erative (Anderson C... Jessamine County, S... County, Woodford C... Frankfort Independent... Franklin County School... the process of developi... application for federal... (EHA-B) to be submit... the Kentucky Departm... Education. The pro... project will improve s... for handicapped child... the above mentioned d... in the following area... interagency planning... coordination of service... provision of related serv... handicapped children... (3) the establishme... model practices for ... severely handica... students. This notice is... published in order to p... the public the opportu... input in planning fo... operation of, the are... perative project. Infor... is on file regardin... project in the respecti... perintendents' offices... application will be sub... to the Departme... Education by June 1, ... Input should be m... writing, prior to that d...

Wendy Ber...
Project I...
Central Ky. Coop...
Jessamine...
Board of Ed...
P.O. B...
Nicholasville, KY

Notice

Notice is hereby giver... Carl W. Smither, 391... Grade Road, Lou... Kentucky 40299, ... qualified as Executor... Will of Tomie Smitl... persons having ... against this estate are... notified to present ...

SOIL ANALYSIS REPORT

SOIL ANALYSIS REPORT

Valley Industries has stopped production using nickel/chromium electroplating line. This line produced the electroplating waste which is classified as hazardous under U.S. EPA regulation 40 CFR 261 and is identified as F006. Currently this waste is stored on site in a 20 yard "roll on" in excess of 90 days. Therefore, this storage area is permitted as a hazardous waste storage area (EPA Facility I.D. No. 8K4D06-298-5099). Both the waste treatment area and the "roll on" are on a concrete pad with a 12" curb. Two non-curbed areas were once used for storage of drumed waste. Since there was a potential for soil contamination from leakage. The Kentucky Division of Waste Management requested that soil samples be tested.

The enclosed figure shows the location drumed waste was stored and the location of soil sampling. Sample location #6 is in an area with no potential for contamination and was used as a control.

Samples were collected at the surface and at a depth of one foot. Initially the samples were digestion with a strong acid. The results of these tests are presented in Table 1 and represent total metals in the soil. The area adjacent to the drumed waste storage area on the south side of the building shows no increase above the control or background station. Samples adjacent to the other drumed storage area show little or no increase for cadmium except at sample location #1. Both chromium and nickel level were higher than the control particularly at sample location #1. Only a small area around location #1 (approximately 20 feet by 20 feet to a depth of 6") contains moderately higher levels than the control area.

A single soil sample from location #1 was also tested using the EP toxicity test. Since all soils collected from the various locations are similar in physical characteristics (brown silty clay) it is reasonable to assume that they have similar cation exchange or leachability. Based on this analysis the leachability of the other samples are estimated in Table 2. These results are also reported as a percentage of the U.S. EPA 40 CFR 261 maximum contaminant levels.

Since the EP toxicity results are only a very small percentage of the maximum contaminant levels. These soils should not be considered contaminated. Even the small amount of soil at location #1 (approximately 7 cubic yards) does not present a hazard if left in place.

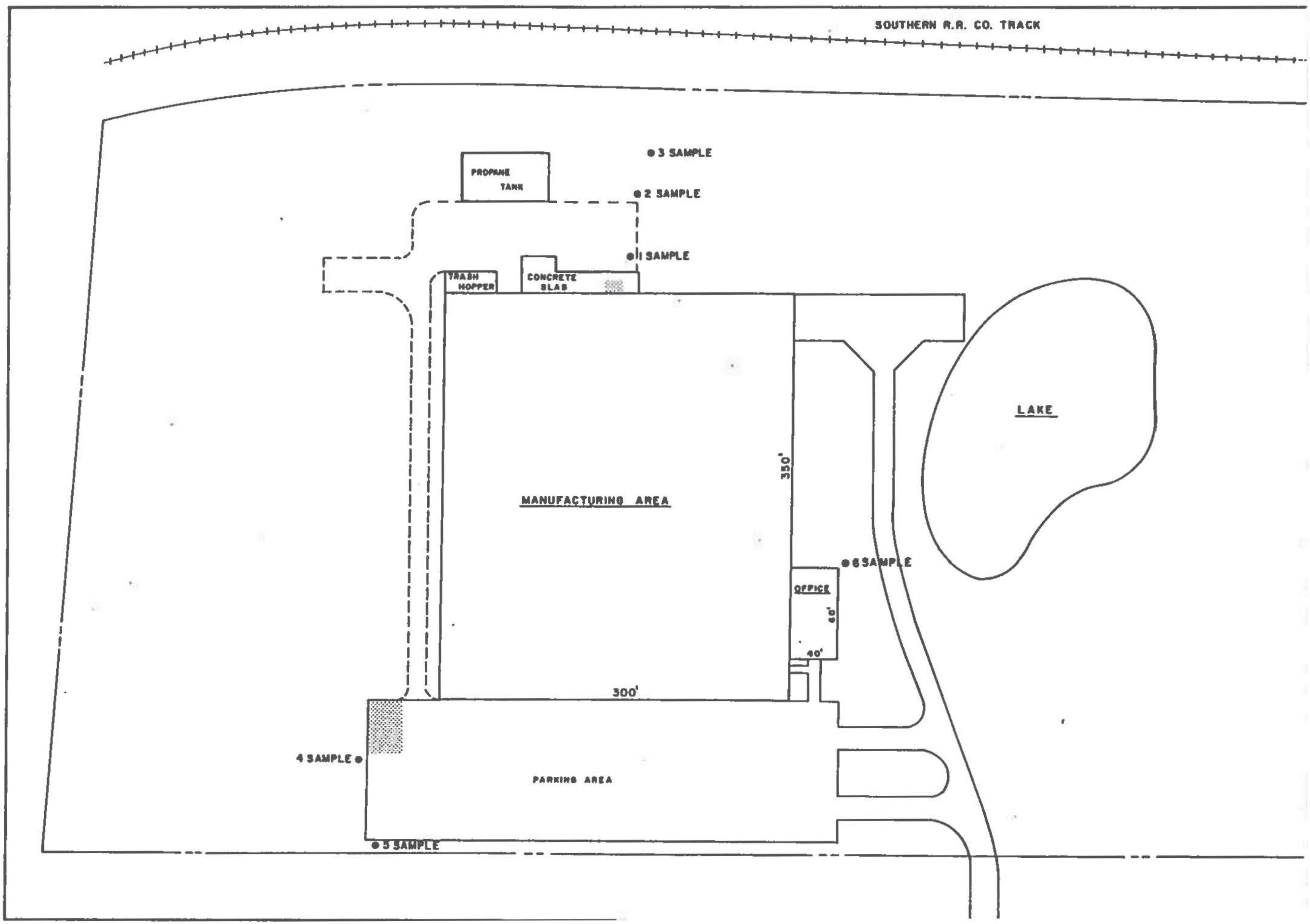

SOUTHERN R.R. CO. TRACK
3 SAMPLE
PROPANE TANK
2 SAMPLE
1 SAMPLE
TRASH HOPPER
CONCRETE SLAB
LAKE
350'
MANUFACTURING AREA
6 SAMPLE
OFFICE
40'
40'
300'
4 SAMPLE
PARKING AREA
5 SAMPLE

TABLE 1 Soil Analysis on a Dry Weight Basis Using Total Digestion

Location	Parameters Cadmium mg/Kg (ppm)	 Chromium mg/Kg (ppm)	 Nickel mg/Kg (ppm)
Sample #1			
surface	9	770	3,270
one foot	2	65	194
Sample #2			
surface	1	25	32
Sample #3			
surface	1	31	114
one foot	1	36	183
Sample #4			
surface	1	23	27
Sample #5			
surface	1	18	20
Sample #6*			
surface	1	18	21

*Control

TABLE 2 Soil EP Toxicity Analyses

Location	Cadmium		Chromium		Nickel	
	Value mg/L	Percent of Standard	Value mg/L	Percent of Standard	Value mg/L	Percent of Standard
Standard	1	–	5	–	20	–
Sample #1						
surface	0.03	3.0%	0.01	0.2%	0.33	1.6%
one foot	0.006	0.6%	0.001	0.02%	0.02	0.1%
Sample #2						
surface	0.003	0.3%	0.001	0.02%	0.003	0.02%
Sample #3						
surface	0.003	0.3%	0.001	0.02%	0.01	0.05%
one foot	0.003	0.3%	0.001	0.02%	0.02	0.1%
Sample #4						
surface	0.003	0.3%	0.001	0.02%	0.003	0.02%
Sample #5						
surface	0.003	0.3%	0.001	0.02%	0.002	0.01%
Sample #6*						
surface	0.003	0.3%	0.001	0.02%	0.002	0.01%

*Control

CLOSURE COST

CLOSURE COST

Valley Industries has a chromium electroplating line which uses a non-cyanide system. Associated with this line is a treatment system which consists of a floor drain and neutralization system (two 2500 gallon filter presses). This treatment system produces a semi-solid residue which is stored on a curbed concrete pad in a covered 20 cubic yard "roll on" leased from ILWD. Also, waste was once stored in drums on a concrete pad in two areas of the plant.

Valley Industries intends to close this storage area and sell the chromium electroplating line. The treatment system will be used for the zinc electroplaing line.

Valley Industries approved closure plan requires the following key items:

1) Samples and test soil for areas adjacent to drum storage (results show no significant contamination, note soil analysis report),
2) acid clean the chromium electroplating line,
3) acid clean the floor drains,
4) steam clean the concrete storage pad,
5) treat waste water from pad,
6) drain treatment system, and
7) have waste in "roll on" disposed by ILWD.

Enclosed cost for cleanup do not include manhours for preparation of the closure plan. All other non-administrative costs have been itemized. The equipment and pad cleanup cost include labor cost of plant personnel and cleaning chemicals. Costs are also provided for soil testing by an independent laboratory. Consulting costs are for collection of one soil sample, preparation of the soil analysis report and certification of closure. Also, the cost for tranpsort and disposal cleanup waste are provided along with the advertising cost for public water.

The costs are as follows:

Equipment and Pad	
Labor	$ 6,575
Chemicals	1,225
Soil Analyses	940
Consultant	2,100
Waste Removal	4,700
Public Notice	160
TOTAL	$15,700

APPROVAL OF CLOSURE PLAN

(Letter)

February 17, 1983

File Copy

Mr. Gerald Sebree
Plant Manger
Valley Industries
P.O. Box 231 30
Shelbyville, Kentucky 40065

RE: Hazardous Waste Facility #KYD06-298-5999
Actual Closure Plan #82-53

Dear Mr. Sebree:

Your existing storage facility closure plan was received on February 9, 1983, and reviewed against the requirements of 401 KAR 2:073 Section 6 and 40 CFR 265 Subpart G. Before the plan may be approved, a public notice must be published in a newspaper of general circulation in Shelbyville and the public must be given thirty (30) days to respond. (A suggested notice is enclosed for your use). The publisher should submit a copy of the printed notice accompanied by an affidavit to: Division of Waste Management, Permit Review Branch, 18 Reilly Road, Frankfort, Kentucky 40601.

If no comments are received within thirty (30) days, a letter approving the closure plan will be issued by the Division. This approval is conditional upon adding the following items in the closure certification report:

(1) Analysis for cadmium in the soil contamination samples,
(2) Amount of decontamination residues, if any,
(3) Actual costs of closure,
(4) Deviations from the closure plan, if any, and
(5) Signatures by an independent P.E. and authorized official of your company.

If you have any questions, please contact Mr. George F. Gilbert, Jr., P.E. at (502) 564-6716, Ext. 237.

Sincerely,

Original Signed by

Caroline Patrick Haight
Manager, Permit Review Branch
Division of Waste Management

ASC:GFG:cg

cc: John Brooks, Area Supervisor
Christine Harrington, Enforcement Section

APPROVAL OF SOILS REPORT

(Letter)

JACKIE SWIGART
SECRETARY

JOHN Y. BROWN
Governor

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FORT BOONE PLAZA
18 REILLY ROAD
FRANKFORT, KENTUCKY 40601

May 19, 1983

Mr. Clinton E. Twilley
Retech Associates, Inc.
861 Corporate Drive, Suite 200
Lexington, Kentucky 40503

RE: Closure Plan #82-53, Hazardous Waste Facility EPA I.D. #KYD06-298-5999, Valley Industries, Shelbyville, Kentucky

Dear Mr. Twilley:

The soil sample information submitted with your letter of May 13, 1983, demonstrates a level of soil contamination below the EP toxicity limits of 40 CFR 261.24. Please include the same information in the "certification of closure" as requested in the letter from myself to Mr. Gerald Sebree dated February 17, 1983 (copy enclosed).

The Division of Waste Management still needs a copy of the printed public notice and affidavit of publication also addressed in the above letter.

If you have any questions, please feel free to contact Mr. George F. Gilbert, Jr., P.E., at (502) 564-6716, Ext. 237.

Sincerely,

Caroline Patrick Haight

Caroline Patrick Haight
Manager, Permit Review Branch
Division of Waste Management

CPH:GFG:cg

cc: Howard Wallace, Valley Industries, Lodi, CA.
Gary Craig, Valley Industries, Shelbyville, Ky.
Gerald Sebree, Shelby Industries, Shelbyville, Ky.

7-6

JACKIE SWIGART
SECRETARY

JOHN Y. BROWN
Governor

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION

FORT BOONE PLAZA
18 REILLY ROAD
FRANKFORT, KENTUCKY 40601

July 20, 1983

Mr. Gerald Sebree
Vice President, Manufacturing
Shelby Industries
Division of Prospect Boat Works, Inc.
P. O. Box 308
Industrial Park
Shelbyville, Kentucky 40065

Re: Case closure Valley Industries & Shelby Industries
KYD06-298-5999, Shelby County

Dear Mr. Sebree:

The Division of Waste Management has determined that Shelby Industries, a Division of Prospect Boat Works, Inc., in cooperation with Valley Industries, Division of Scott-Fetzer, has properly closed the hazardous waste storage facility, KYD06-298-5999, in Shelby County, Kentucky.

The firm has substantially complied with the terms of the Agreed Order executed on March 22, 1983, to resolve this matter and as of June 16, 1983, Shelby Industries is in compliance with the Kentucky Waste Management Laws and Regulations. Therefore, the Division of Waste Management has formally closed the enforcement action against Shelby Industries.

This Division appreciates your cooperation in resolving the violations.

Sincerely,

Caroline Patrick Haight

Caroline Patrick Haight
Manager, Permit Review Branch
Division of Waste Management

CPH/JS/pv

cc: Howard Wallace
Gary Craig
John Brooks
Carl Horneman
George Gilbert
James Scarbrough, EPA
Enforcement

alex

FILED
MAR 23 1983
OFFICE OF
GENERAL COUNSEL

RECEIVED
MAR 25 1983
DIVISION OF
WASTE MANAGEMENT

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL
PROTECTION CABINET

IN THE MATTER OF: Shelby Industries
Division of Prospect Boat Works, Inc.

AGREED ORDER

* * * * * * * * * * * * * * * *

WHEREAS, the Natural Resources and Environmental Protection Cabinet (hereinafter the Cabinet) is charged with the statutory duty of enforcing the laws of the Commonwealth of Kentucky relating to the disposal of waste under KRS Chapter 224.

WHEREAS, Prospect Boat Works, Inc. d/b/a Shelby Industries (hereinafter Shelby Industries) is a corporation registered to do business in the Commonwealth of Kentucky.

WHEREAS, Shelby Industries assumed operational rights from Valley Industries Inc., a Division of Scott & Fetzer, to continue manufacturing boat winches and couplers, at the Valley Industries/Shelby Industries plant located on McDaniel Road in Shelby County, Kentucky; and therefore operates a storage facility, KYD06-298-5999, without a permit in violation of KRS Chapter 224.866.

WHEREAS, Shelby Industries is in violation of the following hazardous waste regulations:

1. 401 KAR 35.010 Section 1 - failure to provide adequate inspection logs and personnel training;
2. 401 KAR 35.010 Section 3 - failure to prepare a contingency plan;

3. 401 KAR 35.010 Section 4 - failure to maintain adequate operating records;

4. 401 KAR 35.010 Section 6 - failure to prepare an adequate closure plan;

5. 401 KAR 35.010 Section 7 - failure to submit financial assurance for closure and liability.

WHEREAS, Prospect Boat Works, Inc., d/b/a Shelby Industries has made a commitment to Valley Industries, Inc., a Division of Scott and Fetzer to cooperate in the closure of the storage facility KYD06-298-5999.

NOW THEREFORE, in the interest of settling all claims and controversies involving these matters, the Natural Resources and Environmental Protection Cabinet and Prospect Boat Works, Inc. d/b/a Shelby Industries hereby consent to entry of this AGREED ORDER and agree as follows:

1. That the above statements of fact are true and correct.

2. That Shelby Industries shall upon the execution of this ORDER initiate inspection procedures and logs for the storage facility.

3. That Shelby Industries shall prepare a contingency plan for the storage facility and train affected staff within five (5) days of the execution of this ORDER.

4. That Shelby Industries shall provide assistance and information regarding the closure of storage facility, KYD06-298-5999, to Valley Industries, a Division of Scott and Fetzer, and the Cabinet as requested.

5. That this AGREED ORDER or any provision, condition or date contained herein may be amended, modified, deleted or extended only upon a written request stating the reasons therefore and by either written ORDER of the Secretary or written permission by

the Director of the Division of Waste Management. Any such amendment, modification, deletion or extension shall not affect any other provision, condition or date within the AGREED ORDER unless specifically and expressly so provided by the written ORDER or written permission.

6. This AGREED ORDER relates only to violations set out or referred to in this AGREED ORDER and nothing contained herein shall be construed to waive or limit any remedy or cause of action of the Cabinet based on violations of other laws or regulations under the jurisdiction of any other division of the Cabinet.

7. That strict compliance with all the terms of this AGREED ORDER shall be considered as a satisfactory resolution of the known and alleged violations of KRS Chapter 224 and the laws and regulations promulgated pursuant thereto specifically limited to the above statements of fact.

8. That failure to strictly comply with the terms of this AGREED ORDER shall be grounds for the Cabinet to seek enforcement of this ORDER as well as penalties for its violation and any appropriate action under KRS Chapter 224, including but not limited to, injunctions and penalties pertinent to the above statements of fact.

9. That each separate provision, condition or duty contained herein may be the basis for a separate violation and penalty pursuant to KRS 224.

10. That the AGREED ORDER shall be of no force and effect until it is executed by the Secretary as evidenced by her signature thereon.

Authorized Representative
Prospect Boat Works, Inc. d/b/a
Shelby Industries

Date March 4, 1983

J. Alex Barber, Director
Division of Waste Management

Date 3/7/83

T. Michael Taimi, Commissioner
Department for Environmental Protection

Date 3/15/83

Attorney, Office of General Counsel

Date 3/18/83

* * * * * * * * * * * * * * * * * *

ORDER

WHEREFORE, the Secretary, taking cognizance of the agreement of the parties as evidenced herein, does hereby order that the foregoing AGREED ORDER be, and is hereby entered as the Order of this Natural Resources and Environmental Protection Cabinet this 21 day of March, 1983.

Jackie Swigart
Jackie Swigart, Secretary
Natural Resources and Environmental
Protection Cabinet

CERTIFICATION

I hereby certify that a true copy of the foregoing AGREED ORDER was mailed postage pre-paid, certified mail, to the following this 23 day of March, 1983.

Mr. Gerald Sebree
c/o Shelby Industries
Division of Prospect
McDaniel Road
Shelbyville, Kentucky 40065

and hand delivered to:

Hon. Arthur L. Williams
Office of General Counsel
Fifth Floor, Capital Plaza Tower
Frankfort, Kentucky 40601

Marcia Richmond Morgan
DOCKET COORDINATOR

DISTRIBUTION:
J. Alex Barber, Director
Division of Waste Management
Order File

RETECH

A Resource Technology Company
Consultants in the Environmental & Resource Sciences

RETECH ASSOCIATES, INC
861 Corporate Drive, Suite 200
Lexington, Kentucky 40503
(606) 223-2901

May 13, 1983

RECEIVED
MAY 16 1983
DIVISION OF
WASTE MANAGEMENT

Mr. George Gilbert, P.E.
Division of Waste Management
18 Reilly Road, Fort Boone Plaza
Frankfort, KY 40601

RE: Valley Industries
Closure Plan
No. 82-53

Dear Mr. Gilbert:

Soil sampling and analysis have been completed to assess level of soil contamination at Valley Industries' Shelbyville plant. A report is enclosed which contains results of these analyses.

These data indicate that levels above background exist in a small area. Levels of contamination are quite low and are less than 3 percent of the EP toxicity maximum contaminant levels. We feel these moderate levels in the soil are not a hazard and therefore, the soil could be left in place without any environmental degradation.

If you have any questions, please advise.

Sincerely,
RETECH Associates, Inc.

Clinton Twilley

Clinton E. Twilley

cc: Mr. Howard Wallace, Valley Industries
Mr. Gary Craig, Valley Industries
Mr. Gerald Sebree, Shelby Industries

RECEIVED
MAY 16 1983
DIVISION OF
WASTE MANAGEMENT

SOIL ANALYSIS REPORT

Valley Industries has stopped production using nickel/[illegible] electroplating line. This line produced the electroplating waste which is classified as hazardous under U.S. EPA regulation 40 CFR 261 and is identified as F006. Currently this waste is stored on site in a 20 yard "roll on" in excess of 90 days. Therefore, this storage area is permitted as a hazardous waste storage area (EPA Facility I.D. No. 8K4D06-298-5099). Both the waste treatment area and the "roll on" are on a concrete pad with a 12" curb. Two non-curbed areas were once used for storage of drumed waste. Since there was a potential for soil contamination from leakage. The Kentucky Division of Waste Management requested that soil samples be tested.

The enclosed figure shows the location drumed waste was stored and the location of soil sampling. Sample location #6 is in an area with no potential for contamination and was used as a control.

Samples were collected at the surface and at a depth of one foot. Initially the samples were digestion with a strong acid. The results of these tests are presented in Table 1 and represent total metals in the soil. The area adjacent to the drumed waste storage area on the south side of the building shows no increase above the control or background station. Samples adjacent to the other drumed storage area show little or no increase for cadmium except at sample location #1. Both chromium and nickel level were higher than the control particularly at sample location #1. Only a small area around location #1 (approximately 20 feet by 20 feet to a depth of 6") contains moderately higher levels than the control area.

A single soil sample from location #1 was also tested using the EP toxicity test. Since all soils collected from the various locations are similar in physical characteristics (brown silty clay) it is reasonable to assume that they have similar cation exchange or leachability. Based on this analysis the leachability of the other samples are estimated in Table 2. These results are also reported as a percentage of the U.S. EPA 40 CFR 261 maximum contaminant levels.

Since the EP toxicity results are only a very small percentage of the maximum contaminant levels. These soils should not be considered contaminated. Even the small amount of soil at location #1 (approximately 7 cubic yards) does not present a hazard if left in place.

Valley

Shelby Industries
Division of Prospect Boat Works, Inc.
P. O. Box 308
Industrial Park
Shelbyville, Ky. 40065
Telephone: 502-633-2040

Shelby

April 27, 1983

RECEIVED

APR 28 1983

DIVISION OF
WASTE MANAGEMENT

Mr. J. Alex Barber
Director
Division of Waste Management
Department for Natural Resources
and Environmental Protection
Fort Boone Plaza, Building #2
18 Reilly Road
Frankfort, Kentucky 40601

RE: KY D062985999

Dear Mr. Barber:

We received a request for Part B of the Resource Conservation and Recovery Act on November 22, 1982.

We at that time was in the process of closing the facility, so we did nothing towards the completion of Part B other than to attend the seminar the State had in Louisville, Kentucky. We are now in receipt of a request for Part B. The expiration date is May 22, 1983. We are now in the last process of closing the facility and should be completed the month of May. We need some direction. Should we attempt now to furnish Part B, or not? We should have no problem in getting the facility closed this coming month. I would appreciate some direction as soon as possible.

Thank you.

Sincerely,

Gerald Sebree

Gerald Sebree
Vice President, Manufacturing

GS:jcl

cc: Howard Wallace
George Gilbert
Joe Schmidt

11/22/82

4AW-RM

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. John Gundlach
Vice President, Manufacturing
Scott Fetzer Company
P. O. Box 231
Shelbyville, Kentucky 40065

Re: Part B Request for Scott Fetzer Company, Valley Industries Division
EPA I. D. Number KYD 062 985 999

Dear Mr. Gundlach:

This letter constitutes a formal request for Part B of your application for a hazardous waste facility permit under the Resource Conservation and Recovery Act (RCRA) and the Kentucky Revised Statutes Chapter 224, Environmental Protection, for the above referenced facility. This joint request by the Environmental Protection Agency (EPA) and the Commonwealth of Kentucky, Division of Waste Management is made under the authority of 40 CFR 122.22(a).

The Commonwealth of Kentucky was granted interim authorization for Phase I of the Hazardous Waste Program under RCRA on April 1, 1981; Phase I covers all aspects of the Federal Hazardous Waste Program except permitting. The Kentucky Phase I program is authorized to operate for all areas except permitting in lieu of the Federal Program on an interim basis. Kentucky has submitted a draft application for Phase II interim authorization (the permitting portion) of the Hazardous Waste Program. Until such time as Kentucky's Phase II application is approved, EPA retains full and ultimate responsibility for the administration and enforcement of the RCRA hazardous waste permitting program in the State. However, because Kentucky's Phase II interim authorization program is under review, the State and EPA's permitting processes are being consolidated as much as possible. If Kentucky receives authorization prior to public notice of the draft permit, EPA will not take official action on the permit application but will defer the permit issuance/denial decision to the State.

Enclosed is a copy of the regulations which set forth the information required in the Part B application for your facility. The completed Part B application for your facility must be submitted no later than six (6) months from the date of this request.

Please send one (1) copy of the Part B application to Kentucky Division of Waste Management and four (4) copies to EPA. The mailing addresses of the two agencies are as follows:

Environmental Protection Agency
345 Courtland Street
Atlanta, Georgia 30365
Attention: James H. Scarbrough

Natural Resources and Environmental
Protection Cabinet
Department for Environmental Protection
Ft. Boone Plaza, Building #2
18 Reilly Road
Frankfort, Kentucky 40601
Attention: Pat Haight

In accordance with 40 CFR Part 2, any information except your name and address which you submit to EPA may be claimed as confidential. You must assert such claim by stamping the words "confidential business information" on each page containing such information. If no claim is made at the time of submission, EPA may make the information available to the public without further notice. If a claim is asserted and substantiated, the information will be treated in accordance with the procedures in 40 CFR Part 2 (Public Information).

Should you have any questions concerning these requirements, please contact Ms. Pat Haight, Kentucky Division of Waste Management at 502/564-6716 or Doug McCurry of EPA at 404/881-3433.

Sincerely yours,

Howard Zeller /bv

Charles R. Jeter
Regional Administrator

J. Alex Barber

J. Alex Barber, Director
Division of Waste Management
Department for Environmental Protection

Enclosures

cc: Mr. Howard Wallace, General Manager
Mr. Billie L. Davis, Plant Chemist
Valley Industries Division
Scott Fetzer Company
P. O. Box 231
Shelbyville, Kentucky 40065

DIVISION OF WASTE MANAGEMENT

WASTE MANAGEMENT PERMIT

PERMIT-BY-RULE

Valley Industries
P.O. Box 231
Shelbyville, Kentucky 40065

The Division of Waste Management hereby grants the above-named facility a permit to engage in the activity specified below. This permit does not confere an unqualified right, but is subject to the waste management provisions of KRS Chapter 224 and regulations promulgated pursuant thereto. Conformance with all such laws and regulations is the responsibility of the permittee. Further, this permit is subject to any conditions and operating limitations specified below:

Facility must be operated in accordance with the applicable recordkeeping, operating standards, and reporting procedures in 401 KAR 2:070 as amended.

No deviation from the terms and conditions of this permit is allowed without prior written authorization from the Division. Violation of the terms and conditions specified herein shall render this permit null and void. All rights of inspection by Division of Waste Management representatives are reserved.

Receipt of the permit fee and bond amount specified below is hereby acknowledged.

PERMIT TYPE: Permit-By-Rule

WASTE CATEGORY: Hazardous

CLOSURE FUND: *

CLOSURE INSTRUMENT: *

POSTCLOSURE FUND: N/A

POSTCLOSURE INSTRUMENT: N/A

ACRES: .00257

EFFECTIVE DATE: 3/14/80

*To Be Established 10-13-81

PERMIT NUMBER: KYD06-298-5999-S

TYPE OF ACTIVITY: Container Storage

LIABILITY INSURANCE (SO): *

LIABILITY INSURANCE (NSO): *

PERMIT FEE: $250.00

COUNTY: Shelby

ISSUE DATE: July 23, 1981

EXPIRATION DATE: N/A (401 KAR 2:050 Section 1 (40)

Jimmie L. Hankins

DIRECTOR, DIVISION OF WASTE MANAGEMENT

Valley Industries

Eastern Plant
McDaniel Road
Shelbyville, KY 40065
Telephone (502) 633-2040

RECEIVED
AUG 8 1980
DIV. OF HAZARDOUS MATERIALS
AND WASTE MA[illegible]

August 7, 1980

Division of Hazardous Materials & Waste Management
Attn-Pat Haight
Pine Hill Plaza
1121 Louisville Road
Frankfort, Ky. 40601

Dear Ms. Haight,

This is to inform you of our wish to amend our application for permit as a waste storage facility. We wish to change it to register as a storage facility.

Enclosed is a copy of the original application for your convenience. Please note we wish to add that all sludges from the rinse streams listed on page 7 of the application are put in one container.

Thank you for your cooperation in this matter.

Sincerely,

Billie L Davis

Billie L. Davis
Plant Chemist

APPLICATION FOR A HAZARDOUS WASTE FACILITY PERMIT

PG.

APPLICATION NUMBER

NERAL INFORMATION

FACILITY NAME: VALLEY INDUSTRIES

FACILITY MAILING ADDRESS: P.O. BOX 231, SHELBYVILLE, KY 40065

CONTACT PERSON: BILLIE L. DAVIS TELEPHONE: 502-633-2497

OPERATOR'S NAME: VALLEY INDUSTRIES, DIV. OF THE SCOTT & FETZER CO. 502-633-2040

OPERATOR'S ADDRESS: INDUSTRIAL PARK, SHELBYVILLE, KY 40065

RECEIVED
JUL 1 6 1980
DIV. OF HAZARDOUS MATERIAL AND WASTE MANAGEMENT

PARENT FIRM: THE SCOTT & FETZER, CO

PARENT FIRM ADDRESS: 14600 DETROIT AVE, LAKEWOOD, OH 44107

LEGAL STRUCTURE: [X] CORPORATION [2] NON-PROFIT CORPORATION [3] PARTNERSHIP [4] INDIVIDUAL [5] LOCAL GOVERN [6] STATE GOVERNMENT [7] FEDERAL GOVERNMENT [8] OTHER

IF AN INDIVIDUAL OR PARTNERSHIP, AND BUSINESS IS PERFORMED UNDER AN ASSUMED NAME, SPECIFY COUNTY AN STATE WHERE NAME IS REGISTERED. COUNTY: STATE:

IF A CORPORATION, INDICATE STATE OF INCORPORATION OHIO. IS CORPORATION REGISTERED WITH KENTUCKY SECRETARY OF STATE? [X] YES [2] NO GIVE NAME OF REGISTERED AGENT FOR SERVICE OF PROCESS.

NAME: ~~C. T. CORP. SYSTEMS~~ TELEPHONE: N/A

ADDRESS: KY. HOME LIFE BLDG., LOUISVILLE KY 40202 N/A

IF AN INDIVIDUAL OR PARTNERSHIP, LIST OWNERS. IF A CORPORATION, LIST ALL OFFICERS AND STOCKHOLDERS OWNING 10 PERCENT OR MORE OF ANY CLASS OF STOCK.

NAME: Ralph Schey SOCIAL SECURITY NUMBER: ~~N/A~~

ADDRESS: 14600 DETROIT AVE., LAKEWOOD, OH44107

NAME: J. F. BRADLEY SOCIAL SECURITY NUMBER: N/A

ADDRESS: 14600 DETROIT AVE., LAKEWOOD, OH 44107

NAME: KEN D. HUGHES SOCIAL SECURITY NUMBER: N/A

ADDRESS: ~~14600 DETROIT AVE., LAKEWOOD, OH 44107~~

NAME: ~~ROBERT C. WEBER~~ SOCIAL SECURITY NUMBER: ~~N/A~~

ADDRESS: ~~14600 DETROIT AVE., LAKEWOOD, OH 44107~~

TYPE OF FACILITY: [X] STORAGE [2] INCINERATION [3] LANDFILL [4] SURFACE IMPOUNDMENT [5] INJECTION WELL [6] CHEMICAL TREATMENT [7] BIOLOGICAL TREATMENT [8] PHYSICAL TREATMENT [9] LANDFARM [10] RECYCLER/RECLAIMER

TYPE OF APPLICATION: [1] CONSTRUCTION [X] OPERATING [3] MODIFICATION TO PERMIT NUMBER

FACILITY STATUS: [X] EXISTING [2] PROPOSED [3] MODIFICATION [4] UNDER CONSTRUCTION

PLANT CHEMIST

~~XXXXXXX~~: BILLIE L. DAVIS REGISTRATION NUMBER: n/a

ADDRESS: PO BOX 231 SHELBYVILLE, KY 40065

ASSOCIATED WITH: ~~VALLEY INDUSTRIES, DIV. OF THE SCOTT & FETZER CO.~~

GEOLOGIST: N/A

PERMIT FEE [1] CHECK OR [2] MONEY ORDER NUMBER

[4] LETTER OF CREDIT
IF [2], GIVE BOND NUMBER ______ AND SURETY ______
IF [3], GIVE BANK NAME N/A ______ AND ID NUMBER ______
IF [4], GIVE BANK NAME ______ AND LETTER OF CREDIT NUMBER ______

AMOUNT OF: CLOSURE TRUST FUND ______ POST-CLOSURE TRUST FUND ______

EXISTING ENVIRONMENTAL PERMITS:

NAME OF PERMIT	PERMIT NUMBER	DATE ISSUED	EXPIRATION DATE
AIR POLUTION	0-78-49	9-11-78	NONE
DEWATERED HYDROXIDE SLUDGE		1-11-79	NONE
INDIANA (SEE ATTACHED COPY)			

ITE INFORMATION

FACILITY LOCATION: COUNTY: SHELBY UTM ZONE 16
UTM HORIZONTAL COORDINATE: 4227.9 UTM VERTICAL COORDINATE: 651.9
LATITUDE: 85 deg. 15' 49" LONGITUDE: 38deg 11' 51 sec
NEAREST COMMUNITY: SHELBYVILLE NEAREST NAMED STREAM CLEAR CREEK
NEAREST PUBLIC ROAD INTERSECTION INDUSTRIAL PK RD & MCDANIEL USGS QUADRANGLE SHELBYVILLE

MAJOR WATERSHED(S) AFFECTED: [1] BIG SANDY [2] CUMBERLAND RIVER(UPPER) [3] CUMBERLAND RIVER(LOWER)
[4] GREEN RIVER [5] KENTUCKY RIVER [6] LICKING RIVER [7] LITTLE SANDY RIVER [8] MISSISSIPPI RIVER [9] OHIO
[X] SALT RIVER [11] TENNESSEE RIVER [12] TRADEWATER RIVER [13] TYGARTS CREEK

AREA OF SITE (ACRES) .00257 ESTIMATED LIFE OF OPERATION 25 yrs.

IS WASTE GENERATOR ON SITE? [X] YES [2] NO IF YES, LIST SIC CODE 3469

SITE OWNERSHIP STATUS: [1] OWNED [2] TO BE PURCHASED [3] PRESENTLY LEASED: EXPIRATION DATE OCT. 31,1980
[4] TO BE LEASED FOR ______ YEARS. IF LEASED, GIVE OWNER'S NAME SOCIETY NATIONAL BANK OF CLEV
AND ADDRESS 127 PUBLIC SQUARE CLEVELAND, OH 44114

IS THE SITE LOCATED IN: [1] KNOWN FAULT ZONE [2] KARST ZONE [3] 100 YEAR FLOOD PLAIN [4] WETLAND
[5] A REGULATED FLOODWAY [6] CRITICAL HABITAT [7] RECHARGE ZONE OR SOLE SOURCE AQUIFER [8] DISCHARGE AREA
IF ANY OF THE ABOVE ITEMS WERE CHECKED, GIVE DETAILS N/A

EOLOGIC & SOILS INFORMATION

DESCRIBE THE VARIOUS SOIL TYPES AND GEOLOGIC STRATA PRESENT:

TYPE OR STRATUM	ELEVATION	TYPE OR STRATUM	E
GEOLOGY-GRANT LAKE LIMESTONE	770'		

SOIL PERMEABILITY (cm/sec) TO 3' .0004 cent. per sec. BELOW 3'.0014 cent. per sec

AVERAGE SLOPE OF SITE (%) 0.5-1.52 DIRECTION OF SLOPE W-S
GROUNDCOVER ROCK

GROUNDWATER USE IN VICINITY N/A

POTENTIAL YIELD OF AQUIFER N/A

DISTANCE TO DRINKING WATER SUPPLY 6 MILES DIRECTION EAST

TYPE OF DRINKING WATER SUPPLY: [1] NON-COMMUNITY (<25 CONNECTIONS) [X] COMMUNITY (>25 CONNECTIONS), SP[illegible]
SHELBYVILLE [3] SURFACE WATER [4] WELL

LIST ALL DRINKING WATER WELLS WITHIN 1/4 MILE RADIUS OF SITE:

WELL	DEPTH	LOCATION	COMMUN. NON-CO[illegible]
N/A			

ANNUAL PRECIPITATION RATE 43.61" ANNUALLY EVAPORATION RATE 35" ANNUALLY

LAND USE & POPULATION INFORMATION

PRESENT ZONING OF THE SITE? LIGHT INDUSTRIAL

IF A ZONING CHANGE IS NEEDED, WHAT SHOULD NEW ZONING BE?

PRESENT LANDUSE OF SITE INDUSTRIAL

PRESENT LANDUSE OF AREA CONTIGUOUS TO SITE INDUSTRIAL

POPULATION DIRECTLY AFFECTED BY SITE:

LOCATION OF POPULATION	APPROXIMATE NUMBER OF PEOPLE AFFECTED	APPROXIMATE NUMBER OF BUILDINGS AFFECTED	DISTANCE TO SITE
RESIDENTIAL AREAS	N/A		
COMMERCIAL OR INDUSTRIAL AREAS	400	5 PLANTS	MIN. 300 YDS. MAX. 1 MI.
PUBLICLY TRAVELED AREAS	N/A		
PUBLIC USE AREAS	N/A		

BRIEF DESCRIPTION OF OPERATION

SEE ATTACHED COPY

FOR LOCATION OF DUMPSTER

ATTACHMENTS

THE FOLLOWING ATTACHMENTS ARE ENCLOSED AND MADE AN INTEGRAL PART OF THIS APPLICATION: [X] ENGINEER 2 GEOLOGIC REPORT 3 OPERATIONAL PLAN 4 CONTINGENCY PLAN 5 PROOF OF ZONING COMPLIANCE 6 PROOF OF FINA RESPONSIBILITY 7 NEWSPAPER AFFIDAVIT

NUMBER OF: SUMMARY SHEETS ATTACHED 4 WASTES REPORTED 6

ERTIFICATION

I CERTIFY THAT I HAVE PERSONALLY EXAMINED AND AM FAMILIAR WITH THE INFORMATION SUBMITTED IN THIS ATTACHED DOCUMENTS, AND THAT BASED ON MY INQUIRY OF THOSE INDIVIDUALS IMMEDIATELY RESPONSIBLE FOR OBTAINING THE INFORMATION, I BELIEVE THAT THE SUBMITTED INFORMATION IS TRUE, ACCURATE, AND COMPLE

HOWARD WALLACE	PLANT MANAGER
APPLICANT'S NAME	TITLE

CHROMIUM HYDROXIDE

Hexavalent chromium rinse is reduced to trivalent chromium with sulphur dioxide. The PH is raised to 8.8 with caustic soda where the maximum insolubility of trivalent chromium hydroxide occurs. The product is then filtered through the filter press and final filter, as the attached drawing shows. The supernate is sent to the city sewer and the dried filtrate is taken to the sludge dumpster.

NICKLE HYDROXIDE

The nickle rinse is changed to nickle hydroxide by raising the PH to 11.0 with sodium hydroxide which is the point of maximum insolubility in water for nickle hydroxide. The nickle hydroxide is filtered out in the filter press and final filter. The supernate is sent to the city sewer. The dried filtrate is taken to the sludge dumpster.

ZINC HYDROXIDE AND ACID ALKALI RINSE STREAM *EMULSIFIED OILS STREAM AND PARTS WASHER STREAM

Zinc rinse is dumped into the acid and alkali rinse stream. The stream is pumped to one of the two 2500 gal. tanks. The Ph is adjusted to 10.5-11.0, which is the point of maximum insolubility of zinc hydroxide and also the best clarification point for the acid and alkali rinse stream. A clarifier is added and the material is pumped through the filter press and final filter. The supernate is pumped to the city sewer and the dried filtrate is taken to the sludge dumpster.

*The emulsified oil stream and parts washer stream is periodically dumped into the above waste treatment stream. The only difference is when these are dumped, activated carbon is used to remove the oil. The rest of the procedure is the same as the above.

All sludges from the rinse streams listed above are put in one container.

See attached engineering diagrams for the flow sheets.
All waste materials are treated according to the Standard Methods for the Examination of Water & Waste Water, 14th edition, 1975 APHA-AWWA-WPCS

This is to certify that the above information is correct.

Billie L. Davis

Billie L. Davis
Plant Chemist

Please print or type in the unshaded areas only
(fill-in areas are spaced for elite type, i.e., 12 characters/inch).

1060

Form Approved OMB No. 158-R0175

FORM 1 GENERAL

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY
GENERAL INFORMATION
Consolidated Permits Program
(Read the "General Instructions" before starting.)

I. EPA I.D. NUMBER

F KYD062985999 D

LABEL ITEMS

I. EPA I.D. NUMBER

III. FACILITY NAME

V. FACILITY MAILING ADDRESS

VI. FACILITY LOCATION

KYD062985999
Valley Ind. Div. Of The Scott & Fetzer
P. O. Box 231
PLEASE PLACE LABEL IN THIS SPACE
McDaniel Rd.
Industrial Park
Shelbyville, Ky. 40065

RECEIVED
SEP 2 8 1981
DIVISION OF WASTE MANAGEMENT

GENERAL INSTRUCTIONS

If a preprinted label has been provided, affix it in the designated space. Review the information carefully; if any of it is incorrect, cross through it and enter the correct data in the appropriate fill-in area below. Also, if any of the preprinted data is absent *(the area to the left of the label space lists the information that should appear)*, please provide it in the proper fill-in area(s) below. If the label is complete and correct, you need not complete Items I, III, V, and VI *(except VI-B which must be completed regardless)*. Complete all items if no label has been provided. Refer to the instructions for detailed item descriptions and for the legal authorizations under which this data is collected.

II. POLLUTANT CHARACTERISTICS

INSTRUCTIONS: Complete A through J to determine whether you need to submit any permit application forms to the EPA. If you answer "yes" to any questions, you must submit this form and the supplemental form listed in the parenthesis following the question. Mark "X" in the box in the third column if the supplemental form is attached. If you answer "no" to each question, you need not submit any of these forms. You may answer "no" if your activity is excluded from permit requirements; see Section C of the instructions. See also, Section D of the instructions for definitions of bold-faced terms.

SPECIFIC QUESTIONS	YES	NO	FORM ATTACHED	SPECIFIC QUESTIONS	YES	NO	FORM ATTACHED
A. Is this facility a publicly owned treatment works which results in a discharge to waters of the U.S.? (FORM 2A)		X		B. Does or will this facility *(either existing or proposed)* include a concentrated animal feeding operation or aquatic animal production facility which results in a discharge to waters of the U.S.? (FORM 2B)		X	
C. Is this a facility which currently results in discharges to waters of the U.S. other than those described in A or B above? (FORM 2C)		X		D. Is this a proposed facility *(other than those described in A or B above)* which will result in a discharge to waters of the U.S.? (FORM 2D)		X	
E. Does or will this facility treat, store, or dispose of hazardous wastes? (FORM 3)	X			F. Do you or will you inject at this facility industrial or municipal effluent below the lowermost stratum containing, within one quarter mile of the well bore, underground sources of drinking water? (FORM 4)		X	
G. Do you or will you inject at this facility any produced water or other fluids which are brought to the surface in connection with conventional oil or natural gas production, inject fluids used for enhanced recovery of oil or natural gas, or inject fluids for storage of liquid hydrocarbons? (FORM 4)		X		H. Do you or will you inject at this facility fluids for special processes such as mining of sulfur by the Frasch process, solution mining of minerals, in situ combustion of fossil fuel, or recovery of geothermal energy? (FORM 4)		X	
I. Is this facility a proposed stationary source which is one of the 28 industrial categories listed in the instructions and which will potentially emit 100 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5)		X		J. Is this facility a proposed stationary source which is NOT one of the 28 industrial categories listed in the instructions and which will potentially emit 250 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5)		X	

III. NAME OF FACILITY

1 SKIP VALLEY INDUSTRIES DIV OF THE SCOTT/ FETZER CO

IV. FACILITY CONTACT

A. NAME & TITLE (last, first, & title)	B. PHONE (area code & no.)
2 BILLIE L DAVIS PLANT CHEMIST	502 633 2040

V. FACILITY MAILING ADDRESS

A. STREET OR P.O. BOX

3 P.O. BOX 231

B. CITY OR TOWN	C. STATE	D. ZIP CODE
4 SHELBYVILLE	KY	40065

VI. FACILITY LOCATION

A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER

5 MCDANIEL ROAD

B. COUNTY NAME

SHELBY

C. CITY OR TOWN	D. STATE	E. ZIP CODE	F. COUNTY CODE (if known)
6 SHELBYVILLE	KY	40065	

NTINUED FROM THE FRONT

VII. SIC CODES (4-digit, in order of priority)

A. FIRST		B. SECOND	
3471	(specify) POLISHING PLATING UNDER METAL SERV	7	(specify)

C. THIRD		D. FOURTH	
	(specify)	7	(specify)

VIII. OPERATOR INFORMATION

A. NAME: VALLEY IND DIV OF THE SCOTT & FETZER CO.

B. Is the name listed in Item VIII-A also the owner? ☒ YES ☐ NO

C. STATUS OF OPERATOR (Enter the appropriate letter into the answer box; if "Other", specify.)
F = FEDERAL
S = STATE
P = PRIVATE
M = PUBLIC (other than federal or state)
O = OTHER (specify)

P — PRIVATE

D. PHONE (area code & no.): A 502 633 2040

E. STREET OR P.O. BOX: O BOX 231

F. CITY OR TOWN: SHELBYVILLE

G. STATE: KY

H. ZIP CODE: 40065

IX. INDIAN LAND
Is the facility located on Indian lands? ☐ YES ☐ NO

X. EXISTING ENVIRONMENTAL PERMITS

A. NPDES (Discharges to Surface Water)	B. PSD (Air Emissions from Proposed Sources)	
9 N	9 P	Registration with State of Kentucky as storage facility

C. UIC (Underground Injection of Fluids)	E. OTHER (specify)	
9 U	9 104-3680-0016	(specify) AIR POLLUTION CONTROL PERMIT

D. RCRA (Hazardous Wastes)	E. OTHER (specify)	
9 R	9	(specify) DUMP PERMIT FROM STATE OF IND.

XI. MAP

Attach to this application a topographic map of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in the map area. See instructions for precise requirements.

XII. NATURE OF BUSINESS (provide a brief description)

MANUFACTURE OF TRAILER HITCHES AND RECREATIONAL VEHICLE EQUIPMENT

XIII. CERTIFICATION (see instructions)

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME & OFFICIAL TITLE (type or print)	B. SIGNATURE	C. DATE SIGNED
John Gundlach, Vice Pres. Manufacturing Howard Wallace, General Mgr.	Howard Wallace	11/3/80

COMMENTS FOR OFFICIAL USE ONLY

C

Please print or type in the unshaded areas only (fill—in areas are spaced for elite type, i.e., 12 characters/inch).

Form Approved OMB No. 158-S80004

FORM 3 RCRA

U.S. ENVIRONMENTAL PROTECTION AGENCY

HAZARDOUS WASTE PERMIT APPLICATION

Consolidated Permits Program

(This information is required under Section 3005 of RCRA.)

I. EPA I.D. NUMBER

F K Y D 0 6 2 9 8 5 9 9 9 3 1

FOR OFFICIAL USE ONLY

APPLICATION APPROVED	DATE RECEIVED (yr., mo., & day)	COMMENTS

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below *(mark one box only)* to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA I.D. Number, or if this is a revised application, enter your facility's EPA I.D. Number in Item I above.

A. FIRST APPLICATION *(place an "X" below and provide the appropriate date)*

[X] 1. EXISTING FACILITY *(See instructions for definition of "existing" facility. Complete item below.)*

8 — YR. 73 MO. 11 DAY 27 — FOR EXISTING FACILITIES, PROVIDE THE DATE (yr., mo., & day) OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED *(use the boxes to the left)*

[ ] 2. NEW FACILITY *(Complete item below.)*

YR. ___ MO. ___ DAY ___ — FOR NEW FACILITIES, PROVIDE THE DATE (yr., mo., & day) OPERATION BEGAN OR IS EXPECTED TO BEGIN

B. REVISED APPLICATION *(place an "X" below and complete Item I above)*

[ ] 1. FACILITY HAS INTERIM STATUS

[ ] 2. FACILITY HAS A RCRA PERMIT

III. PROCESSES – CODES AND DESIGN CAPACITIES

A. **PROCESS CODE** — Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code(s) in the space provided. If a process will be used that is not included in the list of codes below, then describe the process *(including its design capacity)* in the space provided on the form *(Item III-C)*.

B. **PROCESS DESIGN CAPACITY** — For each code entered in column A enter the capacity of the process.
1. AMOUNT — Enter the amount.
2. UNIT OF MEASURE — For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

RECEIVED EPA/REGION IV

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
CONTAINER (barrel, drum, etc.)	S01	GALLONS OR LITERS
TANK	S02	GALLONS OR LITERS
WASTE PILE	S03	CUBIC YARDS OR CUBIC METERS
SURFACE IMPOUNDMENT	S04	GALLONS OR LITERS
Disposal:		
INJECTION WELL	D79	GALLONS OR LITERS
LANDFILL	D80	ACRE-FEET *(the volume that would cover one acre to a depth of one foot)* OR HECTARE-METER
LAND APPLICATION	D81	ACRES OR HECTARES
OCEAN DISPOSAL	D82	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	D83	GALLONS OR LITERS
Treatment:		
TANK	T01	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	T02	GALLONS PER DAY OR LITERS PER DAY
INCINERATOR	T03	TONS PER HOUR OR METRIC TONS PER HOUR; GALLONS PER HOUR OR LITERS PER HOUR
OTHER *(Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Item III-C.)*	T04	GALLONS PER DAY OR LITERS PER DAY

UNIT OF MEASURE	UNIT OF MEASURE CODE	UNIT OF MEASURE	UNIT OF MEASURE CODE	UNIT OF MEASURE	UNIT OF MEASURE CODE
GALLONS	G	LITERS PER DAY	V	ACRE-FEET	A
LITERS	L	TONS PER HOUR	D	HECTARE-METER	F
CUBIC YARDS	Y	METRIC TONS PER HOUR	W	ACRES	B
CUBIC METERS	C	GALLONS PER HOUR	E	HECTARES	Q
GALLONS PER DAY	U	LITERS PER HOUR	H		

EXAMPLE FOR COMPLETING ITEM III *(shown in line numbers X-1 and X-2 below)*: A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

C DUP 1

LINE NUMBER	A. PROCESS CODE (from list above)	B. 1. AMOUNT (specify)	B. 2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY	LINE NUMBER	A. PROCESS CODE (from list above)	B. 1. AMOUNT	B. 2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY
X-1	S 0 2	600	G		5				
X-2	T 0 3	20	E		6				
1	S 0 1	15, 135	L		7				
2	T 0 1	39,690	V		8				
3					9				
4					10				

ontinued from the front.

I. PROCESSES *(continued)*

C. SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESSES *(code "T04")*. FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAPACITY.

IV. DESCRIPTION OF HAZARDOUS WASTES

A. EPA HAZARDOUS WASTE NUMBER — Enter the four-digit number from 40 CFR, Subpart D for each listed hazardous waste you will handle. If you handle hazardous wastes which are not listed in 40 CFR, Subpart D, enter the four-digit number*(s)* from 40 CFR, Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.

B. ESTIMATED ANNUAL QUANTITY — For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non-listed waste*(s)* that will be handled which possess that characteristic or contaminant.

C. UNIT OF MEASURE — For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

D. PROCESSES

1. PROCESS CODES:
   For listed hazardous waste: For each listed hazardous waste entered in column A select the code*(s)* from the list of process codes contained in Item III to indicate how the waste will be stored, treated, and/or disposed of at the facility.
   For non-listed hazardous wastes: For each characteristic or toxic contaminant entered in column A, select the code*(s)* from the list of process codes contained in Item III to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed hazardous wastes that possess that characteristic or toxic contaminant.
   Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code*(s)*.
2. PROCESS DESCRIPTION: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER — Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. Select one of the EPA Hazardous Waste Numbers and enter it in column A. On the same line complete columns B,C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In column D(2) on that line enter "included with above" and make no other entries on that line.
3. Repeat step 2 for each other EPA Hazardous Waste Number that can be used to describe the hazardous waste.

EXAMPLE FOR COMPLETING ITEM IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* — A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

LINE NO.	A. EPA HAZARD. WASTE NO *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*				D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
X-1	K 0 5 4	900	P	T 0 3	D 8 0			
X-2	D 0 0 2	400	P	T 0 3	D 8 0			
X-3	D 0 0 1	100	P	T 0 3	D 8 0			
X-4	D 0 0 2							included with above

CONTINUE ON PAGE 3

ntinued from the front.

. DESCRIPTION OF HAZARDOUS WASTES (continued)

E. USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM ITEM D(1) ON PAGE 3.

PROCESS DESCRIPTION (continued from page 3)

LINE #	PROCESS CODE	PROCESS DESCRIPTION
1	T01	redox-precipitation filtration
2	T01	precipitation neutralization filtration
3	T01	neutralization precipitation filtration
4	T01	complexing carbon treatment specific reaction filtration precipitation
5	D80	we propose to drum and enclose in plastic and landfill

EPA I.D. NO. (enter from page 1)

XYD 0 6 2 9 8 5 9 9 9 | T/A C: 3 6

V. FACILITY DRAWING

All existing facilities must include in the space provided on page 5 a scale drawing of the facility *(see instructions for more detail)*.

. PHOTOGRAPHS

All existing facilities must include photographs *(aerial or ground–level)* that clearly delineate all existing structures; existing storage, treatment and disposal areas; and sites of future storage, treatment or disposal areas *(see instructions for more detail)*.

I. FACILITY GEOGRAPHIC LOCATION

LATITUDE (degrees, minutes, & seconds)	LONGITUDE (degrees, minutes, & seconds)
85 15 49	38 11 51

II. FACILITY OWNER

☐ A. If the facility owner is also the facility operator as listed in Section VIII on Form 1, "General Information", place an "X" in the box to the left and skip to Section IX below.

B. If the facility owner is not the facility operator as listed in Section VIII on Form 1, complete the following items:

1. NAME OF FACILITY'S LEGAL OWNER	2. PHONE NO. (area code & no.)
The Scott & Fetzer Co.	216-228-6200

3. STREET OR P.O. BOX	4. CITY OR TOWN	5. ST.	6. ZIP CODE
14600 Detroit Ave.	G Lakewood	Oh	44107

OWNER CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME (print or type)	B. SIGNATURE	C. DATE SIGNED
VALLEY INDUSTRIES DIV. John Gundlach, V.P.-Mfg.	[signature]	[illegible]

X. OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME (print or type)	B. SIGNATURE	C. DATE SIGNED
HOWARD WALLACE, GENERAL MGR.	Howard Wallace	11/3/80

CONTINUE ON PAGE 5

Reference 14

Energy and Environment Cabinet
Kentucky Department for Environmental Protection
Division of Waste Management

Activity: CIN20160002 Inspection

Lead Investigator: McAleer, Lynn

Agency Interest/Permit ID: 39894

Agency Interest Name: Shelby Industries

Agency Interest Address: 175 McDaniel Rd
Shelbyville, KY, 40065

Program: Hazardous Waste

County: Shelby

Type of Agency Interest: MFG-Other Manufacturing (339)

Agency Interest Contact: **Title:** **Phone:**

Purpose: Inspection

Inspection Type: HW CEI Large Quantity Generator

Inspection Date: 2/15/2017 **Start Time:** 01:01 PM **End Time:** 01:31 PM

Latitude: 38.20500400 **Longitude:** -85.25772500

Coordinate Collection Method: Decimal Degrees

Incident ID(s):

General Comments:

On this date and time a routine inspection was attempted at Shelby Industries. Upon arrival, inspector was met by William Yeager, LKS Properties. Mr. Yeager was informed that the purpose of the visit was to conduct a hazardous waste inspection. He stated that Shelby Industries was no longer in business. He was asked if there was any waste left on the property by Shelby Industries. He stated that all waste was still on site, and that the Shelby County Courts appointed Bob Leasure as a Receiver of the company assets; and that he should be contacted for additional information related to the closure of this business. Mr. Yeager took inspector inside the facility to see the waste left behind. There were open concrete sump areas where metal forming and cutting equipment had been removed. Most of them were lined with concrete, but one was not. There were petroleum spills observed in all of these sump areas. At least one of the spills appeared to be into the gravel backfill of the concrete floor (see photos). There were several totes of waste oil observed which appeared to be from the dismantling of the metal forming equipment. There was also a full electroplating line where there were numerous tanks still full of wastewater. This wastewater had in the past been managed as hazardous waste. At the time of this inspection the company was registered with this agency as a Large Quantity Hazardous Waste Generator. Mr. Yeager stated that Shelby Industries has been closed since 10/28/16. Inspector told Mr. Yeager she would get back with him on what actions were required to address waste management issues on site. Following this inspection Mr. Leasure was contacted. He confirmed that Shelby Industries assets were all liquidated, and as of 2/12/17 all remaining residues of the company had been abandoned for LKS Properties to manage. A Notice of Violation will be issued to both Shelby Industries c/o Bob Leasure, and LKS Properties to address the waste left on site.

Person(s) Interviewed:

Name	Organization
Bob Leasure, Court Appointed Receiver	502-583-1945
William Yeager, property manager	LKS Properties, 502-718-3796

Status/Comments:

Requirement	Status	Results or Comments
Has the generator registered with the cabinet and received an EPA ID number as required?. [401 KAR 32:010 Section 3(1)]	V	Shelby Industries is no longer in business. The EPA ID# should be inactivated if the waste is to be disposed by another company. A new Notification of Hazardous Waste Activity must be submitted by the new owner of the facility (whomever will be shipping the hazardous waste off site). Forms were e-mailed to Mr. William Yeager to complete this requirement.
Is hazardous waste generation and on-site management of hazardous waste consistent with registration?. [401 KAR 32:010 Section 3(4)]	V	Hazardous waste is no longer being generated on site. It remains in accumulation under the management of the property owner, LKS Properties. A new Registration Notification to must be submitted to reflect the current information for the one time generation and disposal of hazardous waste.
Has the generator made adequate hazardous waste determinations for wastes generated? [40 CFR 262.11]. [401 KAR 32:010 Section 2]	V	A waste determination needs to be made on each of the tanks/containers of waste that has been left on site.
Has the hazardous waste annual report been prepared and submitted as required? . [401 KAR 32:040 Section 3(1)]	I	An annual report will be required to be submitted by the property owner listed in the new Registration. This is not due til 2018.
Have copies of the annual report been sent to the appropriate Kentucky County Judge Executives? . [401 KAR 32:040 Section 3(3)]	I	Copies of the Annual Report Submitted needs to sent to the County Judge Executives as appropriate.
Are hazardous waste annual reports maintained for a period of three years from the due date of the report? [40 CFR 262.40 (b)]. [401 KAR 32:040 Section 2]	E	
Has an adequate personnel training program been developed and implemented? [40 CFR 265.16(a)(1)]. [401 KAR 35:020 Section 7]	E	
Is the required personnel training conducted by a qualified person? [40 CFR 265.16(a)(2)]. [401 KAR 35:020 Section 7]	E	
Have the appropriate employees been trained as required, including new employees within 6 months? [40 CFR 265.16 (b)]. [401 KAR 35:020 Section 7]	E	
Have applicable employees taken part in an annual review of the required personnel training? [40 CFR 265.16(c)]. [401 KAR 35:020 Section 7]	E	
Does the facility maintain the required personnel records? [40 CFR 265.16(d)]. [401 KAR 35:020 Section 7]	E	
Do the training records include the job title for each position at the facility related to hazardous waste management, and the name of the employee filling each position? [40 CFR 265.16(d)(1)]. [401 KAR 35:020 Section 7]	E	

Requirement	Status	Results or Comments
Do the training records include written job descriptions, which include the requisite skill, education, or other qualifications, and duties of facility personnel assigned to each position? [40 CFR 265.16(d)(2)]. [401 KAR 35:020 Section 7]	E	
Do the training records include a written description of the type and amount of both introductory and continuing training that will be given to each person filling an applicable position? [40 CFR 265.16(d)(3)]. [401 KAR 35:020 Section 7]	E	
Are training records on current personnel kept until closure of the site or facility? Are training records on former employees kept for at least three (3) years from the date the employee last worked at the facility? [40 CFR 265.16(e)]. [401 KAR 35:020 Section 7]	E	
Does the contingency plan describe the actions facility personnel must take in response to fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water at the site or facility? [40 CFR 265.52(a)]. [401 KAR 35:040 Section 3]	E	
Are the provisions of the plan carried out immediately whenever there is a fire, explosion, or release of hazardous waste or hazardous waste constituents which could threaten human health or the environment? [40 CFR 265.51(b)]. [401 KAR 35:040 Section 3]	E	
If the owner or operator has already prepared a Spill Prevention, Control, and Countermeasures (SPCC) Plan, or some other emergency or contingency plan, has the plan been amended to incorporate hazardous waste management provisions that are sufficient to comply with the requirements of this chapter? [40 CFR 265.52(b)]. [401 KAR 35:040 Section 3]	E	
Does the plan describe arrangements agreed to by local police departments, fire departments, hospitals, contractors, and state and local emergency response teams to coordinate emergency services? [40 CFR 265.52(c)]. [401 KAR 35:040 Section 3]	E	
Does the plan list names, addresses and phone numbers (office and home) of all persons qualified to act as emergency coordinator, and is this list kept up to date? Where more than one person is listed, has one person been named as primary emergency coordinator and others listed in the order in which they will assume responsibility as alternates? [40 CFR 265.52(d)]. [401 KAR 35:040 Section 3]	E	

Requirement	Status	Results or Comments
Does the plan include a list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications, alarm systems (internal and external), and decontamination equipment), where this equipment is required? Is the emergency equipment list kept up to date? Does the plan include the location and a physical description of each item on the list, and a brief outline of its capabilities? [40 CFR 265.52(e)]. [401 KAR 35:040 Section 3]	E	
Does the plan include an evacuation plan for facility personnel where there is a possibility that evacuation could be necessary? Does the plan describe signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes (in cases where the primary routes could be blocked by releases of hazardous waste or fires)? [40 CFR 265.52(f)]. [401 KAR 35:040 Section 3]	E	
Is a copy of the contingency plan and all revisions to the plan maintained at the facility? [40 CFR 265.53(a)]. [401 KAR 35:040 Section 4]	E	
Are copies of the contingency plan and all revisions to the plan submitted to all local police departments, fire departments, hospitals, and state and local emergency response teams that may be called upon to provide emergency services? [40 CFR 265.53(b)]. [401 KAR 35:040 Section 4]	E	
Is the contingency plan amended if necessary? [40 CFR 265.54]. [401 KAR 35:040 Section 5]	E	
At all times, is there at least one employee either on the facility premises or on call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility for coordinating all emergency response measures? [40 CFR 265.55]. [401 KAR 35:040 Section 6]	E	
Is the emergency coordinator thoroughly familiar with all aspects of the facility's contingency plan, all operations and activities at the facility, the location and characteristics of waste handled, the location of all records within the facility and the facility layout? [40 CFR 265.55]. [401 KAR 35:040 Section 6]	E	
Does the emergency coordinator have the authority to commit the resources needed to carry out the contingency plan? [40 CFR 265.55]. [401 KAR 35:040 Section 6]	E	
Were the appropriate authorities notified in the event of a release, fire or explosion which threatened human health or the environment outside the facility? [40 CFR 265.56(d)]. [401 KAR 35:040 Section 7]	E	

Requirement	Status	Results or Comments
Did the generator prepare the required implementation report which noted the time, date and details of any incident that required implementing the contingency plan? Was the implementation report submitted within (15) days of the incident? [40 CFR 265.56(j)]. [401 KAR 35:040 Section 7]	E	
Has the generator attempted to make emergency arrangements with local authorities? [40 CFR 265.37(a)]. [401 KAR 35:030 Section 7]	E	
Where state or local authorities decline to enter into emergency arrangements, has the generator documented the refusal? [40 CFR 265.37(b)]. [401 KAR 35:030 Section 7]	E	
If applicable, are the requirements met for the export of hazardous waste? [40 CFR 262.53(a)]. [401 KAR 32:050 Section 4]	E	
Do the hazardous waste manifests contain all the required information? [40 CFR 262.20(a)(1)]. [401 KAR 32:020 Section 1]	E	
Are hazardous waste manifests executed as required? [40 CFR 262.23]. [401 KAR 32:020 Section 4]	I	A copy of the manifest used to ship hazardous waste off site is needed to verify compliance with this requirement for the new owner.
Is the generator copy of each manifest signed in accordance with Sec. 262.23(a) kept for three years or until he receives a signed copy from the designated facility which received the waste? This signed copy must be retained as a record for at least three years from the date the waste was accepted by the initial transporter. [40 CFR 262.40 (a)]. [401 KAR 32:040 Section 2]	E	
If necessary, was an exception report submitted to the cabinet as required? [40 CFR 262.42(a)(2)]. [401 KAR 32:040 Section 4]	E	
Has an adequate land disposal determination been made on waste generated? [40 CFR 268.7(a)(1)]. [401 KAR 37:010 Section 7]	E	
Is dilution in lieu of treatment prohibited as required? [40 CFR 268.3(a)]. [401 KAR 37:010 Section 3]	E	
Has the generator sent a one-time written notice to each treatment or storage facility receiving the waste with the initial shipment of waste, and placed a copy in the file? [40 CFR 268.7(a)(2)]. [401 KAR 37:010 Section 7]	E	
Are satellite accumulation containers located at or near the point of generation, and under control of the operator of the process generating the waste? [40 CFR 262.34(c)(1)]. [401 KAR 32:030 Section 5(1)]	E	No satellite accumulation containers on site.
Is each satellite area limited to fifty-five (55) gallons of hazardous waste or one (1) quart of acutely hazardous waste? [40 CFR 262.34(c)(1)]. [401 KAR 32:030 Section 5 (1)]	E	

Requirement	Status	Results or Comments
Are containers holding hazardous waste in good condition? [40 CFR 265.171]. [401 KAR 35:180 Section 2]	E	
Are hazardous waste containers made of or lined with materials which are compatible with the waste being accumulated? [40 CFR 265.172]. [401 KAR 35:180 Section 3]	E	
Are hazardous waste containers closed, except when it is necessary to add or remove waste? [40 CFR 265.173(a)]. [401 KAR 35:180 Section 4(1)]	E	
Are satellite accumulation containers marked either with the words "Hazardous Waste" or with other words that identify the contents of the containers as required? [40 CFR 262.34 (c)(1)]. [401 KAR 32:030 Section 5(1)]	E	
Is the site maintained and operated to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil or surface water which could threaten human health or the environment? [40 CFR 265.31]. [401 KAR 35:030 Section 2]	V	There were releases observed of what appears to be petroleum in the area of the metal forming presses. This area needs to be cleaned up and assessed.
Is the site equipped with an internal communications or alarm system capable of providing immediate emergency instruction (voice or signal) to facility personnel? [40 CFR 265.32(a)]. [401 KAR 35:030 Section 3]	E	
Is the site equipped with a device, such as a telephone (immediately available at the scene of operations) or a hand-held two (2) way radio, capable of summoning emergency assistance from local police departments, fire departments, or state or local emergency response teams? [40 CFR 265.32(b)]. [401 KAR 35:030 Section 3]	E	
Is the site equipped with portable fire extinguishers, fire control equipment, spill control equipment and decontamination equipment? [40 CFR 265.32(c)]. [401 KAR 35:030 Section 3]	E	
Is the site equipped with water at adequate volume and pressure to supply water hose streams, or foam producing equipment, or automatic sprinklers, or water spray systems? [40 CFR 265.32(d)]. [401 KAR 35:030 Section 3]	E	
Are all facility communications or alarm systems, fire protection equipment, spill control equipment and decontamination equipment where required, tested and maintained as necessary to assure its proper operation in time of emergency? [40 CFR 265.33]. [401 KAR 35:030 Section 4]	E	

Requirement	Status	Results or Comments
In areas where hazardous waste is being poured, mixed, spread or otherwise handled, do all personnel involved in the operation have immediate access to an internal alarm or emergency communication device, either directly or through visual or voice contact with another employee? [40 CFR 265.34(a)]. [401 KAR 35:030 Section 5]	E	
Is aisle space maintained to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment and decontamination equipment to any area of facility operation in an emergency? [40 CFR 265.35]. [401 KAR 35:030 Section 6]	E	
Prior to transportation, is hazardous waste packaged in accordance with applicable DOT regulations? [40 CFR 262.30]. [401 KAR 32:030 Section 1]	E	
Is the date upon which each period of accumulation begins clearly marked and visible for inspection on each container? [40 CFR 262.34(a)(2)]. [401 KAR 32:030 Section 5(1)]	V	Tanks of hazardous waste were not labeled or dated as required.
While being accumulated on-site, is each container and tank labeled or marked clearly with the words "Hazardous Waste"? [40 CFR 262.34(a)(3)]. [401 KAR 32:030 Section 5(1)]	V	Tanks of hazardous waste were not labeled or dated as required.
Are containers operated to prevent leaks and ruptures? [40 CFR 265.173(b)]. [401 KAR 35:180 Section 4]	E	
Does the generator inspect areas where containers are stored, at least weekly, looking for leaks and for deterioration of containers and the containment system caused by corrosion or other factors? [40 CFR 265.174]. [401 KAR 35:180 Section 5]	E	
Are containers holding ignitable or reactive waste located at least fifteen (15) meters (approximately fifty (50) feet) from the facility's property line? [40 CFR 265.176]. [401 KAR 35:180 Section 5]	E	
Does the generator comply with the requirements for incompatible wastes? [40 CFR 265.177]. [401 KAR 35:180 Section 7]	E	
Does the generator comply with the 90-day accumulation time limit? [40 CFR 262.34(a)(1)]. [401 KAR 32:030 Section 5(1)]	V	Hazardous waste was abandoned on site on 10/28/17 by Shelby Industries, and as of the date of this inspection the company has exceeded the 90-day accumulation limit.

Investigator: **Title:** **Date:**

- ☐ N - N-Not Applicable
- ☐ E - E-Not Evaluated
- ☑ V - V-Out of Compliance-NOV
- ☐ C - C-No Violations observed

- [ ] I - I-No Violations obs-but impending viol trends obs
- [ ] D - D-Out of Compliance-Violations Documented
- [ ] O - O-Out of Comp-LOW non-recurrent Adm. or O&M

Received By: **Title:** **Date:**

Delivery Method:

Reference 15

Phelps, Daniel (EEC)

From:	McAleer, Lynn (EEC)
Sent:	Wednesday, May 03, 2017 12:04 PM
To:	York, Duke (EEC)
Cc:	Phelps, Daniel (EEC)
Subject:	FW: Pit Analytical Results
Attachments:	Shelby Industries Analysis on Pit 4 Water 5-2-17.pdf

Here are the results on the water that was coming up into the corrugated piping in one of the metal working pits. I am guessing that the oil and grease result is from powerwashing the floor and collecting the wastewater in the pit for final removal. What is DWM's action level for oil and grease?

From: Doug Linebach [mailto:DLinebach@lfienv.com]
Sent: Wednesday, May 03, 2017 11:28 AM
To: McAleer, Lynn (EEC) <Lynn.McAleer@ky.gov>
Cc: Vivek Sarin <vivek@juvocompany.com>
Subject: Pit Analytical Results

Hi Lynn,

It was a pleasure meeting with you yesterday. Attached are the lab results for the one pit water sample from Shelby Industries that Evergreen collected last week. The results are as we expected, with oil and grease showing up due to the residual oils remaining in/on the concrete walls and bottom of the pits.

If you have any questions or comments. Please let me know.

Thanks again for meeting with me yesterday and we'll keep you posted on how thing progress.

Doug

Doug Linebach
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Louisville, Kentucky 40207
(502) 895-5009 Office
(502) 721-5700 Direct
dlinebach@lfienv.com
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MICROBAC®

CERTIFICATE OF ANALYSIS

7041512

Evergreen AES Environmental Services
Raymond Williams
1000 South 1st Street
Shelbyville, KY 40065

Date Reported	05/02/2017
Date Due	05/04/2017
Date Received	04/25/2017
Customer #	EE012

Wastewater Analysis

Analysis	OOC	Qualifier	Result	Units	Min	Max	Method	Rpt Limit	Analysis Date	Tech
Sample: 01 **P452 #1**									**Sampled** 04/25/2017 @ 9:00	
Sampled By Customer										
Oil and Grease, Total			42.3	mg/L			EPA 1664B	5.2	05/01/2017 10:56	KVA
Total Mercury by CVAA							SW-846 7470A			
Mercury			<0.00020	mg/L				0.00020	04/28/2017 11:34	CGL
METALS, TOTAL - 8 RCRA										
Total RCRA Metals							SW846 6010D			
Arsenic			<0.025	mg/L				0.025	04/26/2017 20:32	EML
Barium			0.031	mg/L				0.0050	04/26/2017 20:32	EML
Cadmium			<0.0050	mg/L				0.0050	04/26/2017 20:32	EML
Chromium			<0.0050	mg/L				0.0050	04/26/2017 20:32	EML
Lead			<0.0050	mg/L				0.0050	04/26/2017 20:32	EML
Selenium			<0.025	mg/L				0.025	04/26/2017 20:32	EML
Silver			<0.0050	mg/L				0.0050	04/26/2017 20:32	EML

Qualifier Definitions

The following analyses were subcontracted to a qualified laboratory:

Laboratory	Analysis	Method
Microbac Laboratories, Inc. - Chicagoland	Total Mercury by CVAA	SW-846 7470A

Microbac Laboratories, Inc.

3323 Gilmore Industrial Blvd. Louisville, KY 40213 502.962.6400 Fax: 502.962.6411
Evansville 812.464.9000 | Lexington 859.276.3506 | Paducah 270.898.3637 | Hazard 606.487. 0511

CERTIFICATE OF ANALYSIS

7041512

Evergreen AES Environmental Services
Raymond Williams

Date Due	05/04/2017
Date Received	04/25/2017

Wastewater Analysis

THIS REPORT HAS BEEN REVIEWED AND APPROVED FOR RELEASE:

Laura Revlett A.M.

David Lester, Managing Director

As regulatory limits change frequently, Microbac advises the recipient of this report to confirm such limits with the appropriate Federal, state, or local authorities before acting in reliance on the regulatory limits provided.

For any feedback concerning our services, please contact David Lester, Managing Director at 502.962.6400 or Rob Crookston, President at president@microbac.com.

Microbac Laboratories, Inc.

3323 Gilmore Industrial Blvd. Louisville, KY 40213 502.962.6400 Fax: 502.962.6411
Evansville 812.464.9000 | Lexington 859.276.3506 | Paducah 270.898.3637 | Hazard 606.487. 0511

7041512 LAURA REVLETT

MICROBAC
CHAIN OF CUSTODY
www.microbac.com

3323 Gilmore Industrial Blvd. Louisville, KY 40213 502.962.6400 p 502.962.6411 f
2520 Regency Rd. Lexington, KY 40503 859.276.3506 p 859.278.5665 f
2701 N. Cullen Ave., Ste. A Evansville, IN 47715 812.464.9000 p 812.424.0667 f
5309 Reidland Rd. Paducah, KY 42003 270.898.3637 p 270.898.3666 f
100 Grand Vue Plaza, Ste. 22 Hazard, KY 41701 606.487.0511 p 606.910.0086 f

Client: Evergreen AES
Street Address: 1008 Kiu St. St.
City / State / Zip: Shelbyville, Ky 40065
Phone: (502) 442-6636 Fax: ( )
Email: vwilliams@evergreenaes.com
Attention: Raymond PO #:
Sampler: Raymond
Site / Project Name:

Due Date:

Analyses Requested

	Date / Time	Sample ID / Description	Number of Containers	Type of Container Plastic, clear glass, vial, etc.	Preservative in Container None, HNO₃, H₂SO₄, NaOH, etc.	Sample Matrix Soil, Sludge, Water, Oil, etc.	RUSH* (Fill-in desired TAT)	Oil/Grease Total	Total metals RCRA										
	4.25.17 9:00	P4S2 #1	1	Glass	✓			1	X										
	4.25.17 9:05	P4S2 #1	2	plastic					2										

Relinquished By: Raymond Williams	Date: 4/25/17	Time: 11:45	Notes:
Received By: Bea Smith	Date: 4/25/17	Time: 11:45	
Relinquished By:	Date: / /	Time:	
Received By:	Date: / /	Time:	
Relinquished By:	Date: / /	Time:	To be filled out by Microbac: Temp. Upon Receipt (°C): 14.4 C Thermometer ID: L.22 No. Bottles Received: 3
Received By:	Date: / /	Time:	Samples Received on Ice? Yes No Custody Seals Intact? Yes No N/A

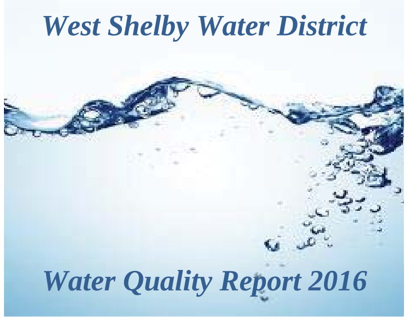
Version 05.19.2015 *Standard RUSH TAT Charges: Same Day x3; Next Day x2; Three Day x1.5. Please contact us for RUSH request arrangements at 502.962.6400

Reference 16

Some or all of these definitions may be found in this report:

Maximum Contaminant Level (MCL) - the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.
Maximum Contaminant Level Goal (MCLG) - the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.
Maximum Residual Disinfectant Level (MRDL) - the highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
Maximum Residual Disinfectant Level Goal (MRDLG) - the level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
Below Detection Levels (BDL) - laboratory analysis indicates that the contaminant is not present.
Not Applicable (N/A) - does not apply.
Parts per million (ppm) - or milligrams per liter, (mg/l). One part per million corresponds to one minute in two years or a single penny in $10,000.
Parts per billion (ppb) - or micrograms per liter, (µg/L). One part per billion corresponds to one minute in 2,000 years, or a single penny in $10,000,000.
Parts per trillion (ppt) - one part per trillion corresponds to one minute in 2,000,000 years, or a single penny in $10,000,000,000.
Parts per quadrillion (ppq) - one part per quadrillion corresponds to one minute in 2,000,000,000 years or one penny in $10,000,000,000,000.
Picocuries per liter (pCi/L) - a measure of the radioactivity in water.
Millirems per year (mrem/yr) - measure of radiation absorbed by the body.
Million Fibers per Liter (MFL) - a measure of the presence of asbestos fibers that are longer than 10 micrometers.
Nephelometric Turbidity Unit (NTU) - a measure of the clarity of water. Turbidity has no health effects. However, turbidity can provide a medium for microbial growth. Turbidity is monitored because it is a good indicator of the effectiveness of the filtration system.
Variances & Exemptions (V&E) - State or EPA permission not to meet an MCL or a treatment technique under certain conditions.
Action Level (AL) - the concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system shall follow.
Treatment Technique (TT) - a required process intended to reduce the level of a contaminant in drinking water.

Spanish (Español) Este informe contiene información muy importante sobre la calidad de su agua beber. Tradúzcalo o hable con alguien que lo entienda bien.



Water System ID: KY1060457
General Manager: Steve Eden
502-722-8944
CCR Contact: Lisa Didier
502-722-8944
seden@westshelbywater.org

Mailing address:
P.O. Box 39
Simpsonville, KY 40067

Meeting location and time:
7101 Shelbyville Rd. Simpsonville, KY
Third Thursday each month at 8:30 AM

This report is designed to inform the public about the quality of water and services provided on a daily basis. Our commitment is to provide a safe, clean, and reliable supply of drinking water. We want to assure that we will continue to monitor, improve, and protect the water system and deliver a high quality product.

Water Purchased From Shelbyville

(serves approximately 200 customers in Shelbyville area.) Shelbyville Municipal Water treats surface water from Guist Creek Lake. A Source Water Assessment Plan indicates that the susceptibility to potential contamination for Guist Creek Lake is ranked medium. A summary of that plan includes four (4) underground petroleum sites and one above ground petroleum storage tank. In addition, there were two bridges; one inactive landfill, and one site (BellSouth) which uses hazardous waste materials. Other potential contaminant concerns include major transportation corridors and commercial activities. The complete plan is available for inspection at Kentuckiana Regional Planning and Development Agency (502-266-6084), located at 11520 Commonwealth Drive, Louisville, KY 40299. This report is also available for review during regular business hours at our District office at 7101 Shelbyville Rd, Simpsonville, KY.

Water Purchased From Louisville

(Serves all customers with exception of Shelbyville area.)
Louisville Water operates two surface water treatment plants with intakes on the Ohio River. A Source Water Assessment and Protection Plan for Jefferson County identified spills of hazardous materials on the Ohio River and permitted discharges of sanitary sewers as the highest contamination risks. In Jefferson County, land use in the protection area is primarily zoned for residential and commercial use, with only a few industrial sites. In Oldham and Trimble Counties (areas bordering the Ohio River to the north of our intakes) land use is primarily zoned for residential and agricultural use. Therefore source water contamination risks are relatively low. To view the entire Source Water Assessment and Protection Plan contact Keith Coombs at 502-569-3682.
Louisville Water also draws water through the aquifer with riverbank filtration wells at the B.E. Payne Plant. The Kentucky Division of Water approved LWC's Wellhead Protection Plan (WHPP) in 2014. The goal is to safeguard groundwater feeding into the wells from contamination within the Wellhead Protection Area (WHPA) in Prospect. Louisville Water continually updates the plan. To view the entire Wellhead Protection Plan contact Kay Ball at 502-569-3688.

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects may be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791).

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and may pick up substances resulting from the presence of animals or from human activity. Contaminants that may be present in source water include: Microbial contaminants, such as viruses and bacteria, (sewage plants, septic systems, livestock operations, or wildlife). Inorganic contaminants, such as salts and metals, (naturally occurring or from stormwater runoff, wastewater discharges, oil and gas production, mining, or farming). Pesticides and herbicides, (stormwater runoff, agriculture or residential uses). Organic chemical contaminants, including synthetic and volatile organic chemicals, (by-products of industrial processes and petroleum production, or from gas stations, stormwater runoff, or septic systems). Radioactive contaminants, (naturally occurring or from oil and gas production or mining activities). In order to ensure that tap water is safe to drink, EPA prescribes regulations that limit the amount of certain contaminants in water provided by public water systems. FDA regulations establish limits for contaminants in bottled water to provide the same protection for public health.

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

Information About Lead:
If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. Your local public water system is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead.

The data presented in this report are from the most recent testing done in accordance with administrative regulations in 401 KAR Chapter 8. As authorized and approved by EPA, the State has reduced monitoring requirements for certain contaminants to less often than once per year because the concentrations of these contaminants are not expected to vary significantly from year to year. Some of the data in this table, though representative, may be more than one year old.

L = Louisville Water S = Shelbyville W = West Shelby	Allowable Levels	Source	Highest Single Measurement	Lowest Monthly %	Violation	Likely Source of Turbidity
Turbidity (NTU) TT * Representative samples of filtered water	No more than 1 NTU* Less than 0.3 NTU in 95% monthly samples	L= S=	0.13 0.36	100 99	No	Soil runoff

Regulated Contaminant Test Results

Contaminant [code] (units)	MCL	MCLG	Source	Report Level	Range of Detection	Date of Sample	Violation	Likely Source of Contamination
Total Coliform Bacteria # or % positive samples	TT	N/A	W=	1	N/A	2016	No	Naturally present in the environment
Barium [1010] (ppm)	2	2	S=	0.02	0.01 to 0.02	2016	No	Drilling wastes; metal refineries; erosion of natural deposits
Copper [1022] (ppm) sites exceeding action level 0	AL = 1.3	1.3	W=	0.970 (90th percentile)	0.005 to 0.48	2014	No	Corrosion of household plumbing systems
Cyanide [1024] (ppb)	200	200	S=	20	0 to 20	2016	No	Discharge from steel/metal factories; plastic and fertilizer factories
Fluoride [1025] (ppm)	4	4	L= S=	0.6 0.82	0.6 to 0.6 0.73 to 0.9	2016 2016	No	Water additive which promotes strong teeth
Lead [1030] (ppb) sites exceeding action level 0	AL = 15	0	W=	0 (90th percentile)	0 to 3	2014	No	Corrosion of household plumbing systems
Nitrate [1040] (ppm)	10	10	L= S=	0.3 1.1	0 to 0.3 0 to 1.1	2016 2016	No	Fertilizer runoff; leaching from septic tanks, sewage; erosion of natural deposits
Atrazine [2050] (ppb)	3	3	S=	0.56	0 to 0.56	2016	No	Runoff from herbicide used on row crops
Di(2-ethylhexyl)phthalate [2039] (ppb)	6	0	S=	0.53	0 to 0.53	2016	No	Discharge from rubber and chemical factories
Total Organic Carbon (ppm) (report level=lowest avg. range of monthly ratios)	TT*	N/A	L= S=	1.00 1.59	1 to 1.18 1.5 to 2.75 to	2016 2016	No	Naturally present in environment.
*Monthly ratio is the % TOC removal achieved to the % TOC removal required. Annual average must be 1.00 or greater for compliance.								
Chloramines (ppm)	MRDL = 4	MRDLG = 4	W=	1.89 (highest average)	0.64 to 2.64	2016	No	Water additive used to control microbes.
HAA (ppb) (Stage 2) [Haloacetic acids]	60	N/A	W=	61 (average)	7 to 51.1 (range of individual sites)	2016	YES	Byproduct of drinking water disinfection
TTHM (ppb) (Stage 2) [total trihalomethanes]	80	N/A	W=	62 (average)	16 to 52 (range of individual sites)	2016	No	Byproduct of drinking water disinfection.

Other Contaminants								
Cryptosporidium [oocysts/L]	0	TT (99% removal)	L= S=	1 1 (positive samples)	24 9 (no. of samples)	2016 2016	See Note Below	Human and animal fecal waste

Cryptosporidium. We are required to monitor the source of your drinking water for Cryptosporidium in order to determine whether treatment at the water treatment plant is sufficient to adequately remove Cryptosporidium from your drinking water.

Unregulated Contaminants (UCMR 3)		average	range (ppb)	date
strontium	S=	104	97 to 120	2013-14
chromium-6	S=	0.098	0.069 to 0.13	2013-14
total chromium	S=	0.145	0.2 to 0.29	2013

EPA has not established drinking water standards for unregulated contaminants. There are no MCL's and therefore no violations if found.

West Shelby Violations
2016-9548619 (MCL-HAA)
During the first quarter of 2016 we exceeded the MCL for HAA. Some people who drink water containing haloacetic acids in excess of the MCL over many years may have an increased risk of getting cancer. Public notices were issued and submitted.

2016-9548620 (Public Notice Linked to Violation)
We failed to properly issue a Public Notice for third quarter of 2015 for exceeding the MCL for HAA (Violation 2016-9548616):

Our water system recently violated a drinking water standard. Although this incident was not an emergency, as our customers, you have a right to know what happened and what we did (are doing) to correct this situation.

We routinely monitor for the presence of drinking water contaminants. Testing results from 7/1/2015-9/30/2015 show that our system exceeds the standard, or maximum contaminant level (MCL) for haloacetic acids (HAA). The standard for HAA is 0.060 mg/L. This is determined by averaging all samples collected by our system for the last 12 months. The level of HAA averaged at our system for 7/1/2015-9/302015 was 0.062 mg/L.

There is nothing you need to do . You do not need to boil your water or take other corrective actions. If a situation arises where the water is no longer safe to drink, you will be notified within 24 hours.
If you have a severely compromised immune system, have an infant, are pregnant, or are elderly, you may be at increased risk and should seek advice from your health care providers about drinking this water.

Some people who drink water containing haloacetic acids in excess of the MCL over many years may have an increased risk of getting cancer.

We are working to minimize the formation of haloacetic acids while ensuring we maintain an adequate level of disinfectant. As of second quarter 2016, we have returned to compliance.

For more information, please contact Steve Eden at 502-722-8944 or PO Box 39, Simpsonville, KY 40067.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This report will not be mailed unless requested. Copies are available at our office. If you desire a copy to be mailed to you please contact our office.

Reference 17

Clear Creek

Return to Waterbodies

Miscellaneous

Fishing Forecast

Access Sites (Click the access site name for more information)

Show Handicap Accessible Sites Only: ○ Yes ◉ No

◉ All Types ○ Any Boat ○ Small Boat ○ Carry Down Only ○ Bank Access ○ Fishing Pier

Name	Map Ref	Type	Ramp Surface	Fee	Marina	County
Clear Creek Access	7	Carry-down only	None	No	None	Shelby

Reference 18

FGDC–STD-004-2013
Second Edition

Classification of Wetlands and Deepwater Habitats of the United States

Adapted from Cowardin, Carter, Golet and LaRoe (1979)

Wetlands Subcommittee
Federal Geographic Data Committee

August 2013

Federal Geographic Data Committee

Established by Office of Management and Budget Circular A-16, the Federal Geographic Data Committee (FGDC) promotes the coordinated development, use, sharing, and dissemination of geographic data.

The FGDC is composed of representatives from the Departments of Agriculture, Commerce, Defense, Energy, Housing and Urban Development, the Interior, State, and Transportation; the Environmental Protection Agency (EPA); the Federal Emergency Management Agency (FEMA); the Library of Congress; the National Aeronautics and Space Administration (NASA); the National Archives and Records Administration; and the Tennessee Valley Authority. Additional Federal agencies participate on FGDC subcommittees and working groups. The Department of the Interior chairs the committee.

FGDC subcommittees work on issues related to data categories coordinated under the circular. Subcommittees establish and implement standards for data content, quality, and transfer; encourage the exchange of information and the transfer of data; and organize the collection of geographic data to reduce duplication of effort. Working groups are established for issues that transcend data categories.

For more information about the committee, or to be added to the committee's newsletter mailing list, please contact:

Federal Geographic Data Committee Secretariat
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World Wide Web: http://fgdc.er.usgs.gov/fgdc.html

This standard should be cited as:

Federal Geographic Data Committee. 2013. Classification of wetlands and deepwater habitats of the United States. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington, DC.

Preface

The *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979) was developed to support a detailed inventory and periodic monitoring of the Nation's wet habitats using remote sensing. It became a National Standard in 1996 (FGDC-STD-004), but has been the *de facto* standard for mapping U.S. wetlands and deepwater habitats since 1976. As of February 2013, the U.S Fish and Wildlife Service's (FWS) National Wetlands Inventory (NWI) had produced wetland data for nearly the entire country. Digital data were available for 89% of the continental United States, 34% of Alaska, 100% of the Hawaiian Islands, 76% of Puerto Rico and the U.S. Virgin Islands and 100% of Guam and Saipan in the Pacific Trust Territories. These data have been incorporated in five reports to Congress on the *Status and Trends of Wetlands and Deepwater Habitats of the Conterminous United States* and more than a hundred regional, state, local, watershed and special interest reports. The classification system (Cowardin et al. 1979) has been cited extensively in the scientific literature and applied internationally.

Shortly after publication of the classification, a National list of hydrophytes and other plants occurring in wetlands and deepwater habitats and a National list of hydric soils were released to support the classification and inventory work. Maintenance of these lists has been a significant, complex task. The U.S. Department of Agriculture's Natural Resources Conservation Service has responsibility for managing the hydric soils list (USDA 2010), and the U.S. Army Corps of Engineers maintains the plant list (Lichvar and Kartesz 2009).

Preparation of this second edition of the Wetlands Classification Standard began in the spring of 2010. Over the last three years, a great number of people reviewed drafts of the revised report and submitted edits, questions, and suggestions for improvement. Among the reviewers were present and past staff of the National Wetlands Inventory; members of the Wetlands Mapping Standard Working Group, which was reconvened specifically to work on this revision; and other Federal and private-sector wetland specialists and contractors. Among the most important contributors were: Ralph Tiner, National Wetlands Inventory, FWS; Larry Handley, U.S. Geological Survey; and Jane Awl, Wetland Mapping Consortium. Thanks also go to Mark Newcastle, Printing and Publishing, FWS for his professional help in redrafting the figures. I am indebted to my wife, Carol Wilen, for allowing me to spend too many Saturdays, Sundays and holidays focused on this, and other, work-related projects.

Special thanks go to Dr. Frank Golet, Professor Emeritus at the University of Rhode Island and one of the authors of the original classification (Cowardin et al. 1979). His detailed, comprehensive reviews of numerous drafts helped to assure that all revisions were technically sound and consistent with both current science and the structure and intent of the original classification. His careful editing also has enhanced the clarity and user-friendliness of this document.

I look back on a long haul made pleasurable by the opportunity of working again with old friends, as well as a new generation of colleagues who will use this classification system going forward.

Bill Wilen
National Wetlands Inventory
U.S. Fish and Wildlife Service
March 2013

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1. Introduction

Wetlands and deepwater habitats are essential breeding, rearing, and feeding grounds for many species of fish and wildlife. They also perform flood protection, pollution control and a variety of other important functions. National and international recognition of the beneficial roles of wetlands has intensified the need for reliable information on the status and extent of wetland resources. To develop comparable information over large areas, a clear definition and classification of wetlands and deepwater habitats are required.

The United States Fish and Wildlife Service (USFWS) has a long history of involvement in wetlands classification and inventory. Conservation and management of migratory waterfowl are a responsibility of the USFWS based on migratory bird treaties with Canada and Mexico. Thus, conservation of wetland habitats is one of the agency's primary objectives. The USFWS conducted the first quantitative national inventory of wetlands in the mid-1950s; the results were summarized in U.S. Fish and Wildlife Service Circular 39 (Shaw and Fredine 1956). That inventory was based on a classification, developed by Martin et al. (1953), which included 20 classes of wetlands. The Martin et al. classification was inconsistently applied among regions primarily because of a lack of detail in the definitions of wetland types (Cowardin et al. 1979). By the mid-1970s, there was a surge of public and professional interest in wetlands that transcended the habitat function for migratory birds.

In January of 1975, the USFWS convened a small number of interested individuals from various agencies and regions to formulate the skeleton of a new classification that could serve as the basis for a new National Wetlands Inventory (NWI). Three important points were agreed upon: (1) none of the existing classifications met the requirement for national uniformity, (2) regional classifications would not suffice because of the confusion resulting at regional boundaries, and (3) a new classification should be hierarchical in structure.

Following that meeting, Lewis M. Cowardin, USFWS, and Virginia Carter, U.S. Geological Survey (USGS), prepared a tentative classification that was presented at a July 1975 national workshop, where 150 Federal, Tribal and state wetlands management personnel were invited to comment on the proposed classification (Sather 1976). Input from that workshop resulted in major modifications of the Cowardin and Carter paper and led to the preparation of a revision, *Interim Classification of Wetlands and Aquatic Habitats of the United States* (Cowardin et al. 1976). Francis C. Golet, University of Rhode Island, and Edward T. LaRoe, National Oceanographic and Atmospheric Administration (NOAA), joined Cowardin and Carter as co-authors of the 1976 document and subsequent versions of the classification system. The Interim Classification was tested using both high- and low-altitude aerial photographs and field-checks at 21 sites scattered across the country. NWI staff worked with the authors to resolve practical problems encountered during extensive test mapping. At the same time, the authors tested the evolving classification at numerous locations throughout the U.S. The final version was published in 1979 as the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979). It was reprinted with technical revisions and additional plates in 1985 and reprinted again in larger format in 1992. The classification was adopted by the Federal Geographic Data Committee (FGDC) as a National Standard (FGDC-STD-004) in 1996. That was the governing document until the Second Edition was published in 2013.

1.1 Objectives

The primary objective of the *Classification of Wetlands and Deepwater Habitats of the United States*, as originally drafted by Cowardin et al. (1979:3), was "to impose boundaries on natural ecosystems for the purposes of inventory, evaluation, and management." The FGDC Wetlands Classification Standard (WCS) provides minimum requirements and guidelines for classification of both wetlands and deepwater habitats that are consistent with the FGDC Wetlands Mapping Standard (FGDC-STD-015-2009).

1.2 Scope

Any new, updated, or revised mapping of wetlands or deepwater habitats shall conform to the FGDC Wetlands Classification Standard. More general mapping activities may incorporate wetlands data from the National Spatial Data Infrastructure (NSDI), rather than conducting new wetlands classification (see further information in the FGDC Wetlands Mapping Standard).

The *Classification of Wetlands and Deepwater Habitats of the United States* was developed by wetland ecologists, with the assistance of many private individuals and organizations and local, state, and Federal agencies. It was designed for use over a broad geographic area—all U.S. States and Territories—by individuals and organizations with varied interests and objectives. The definition of wetland in this classification delimits the biological extent of wetland, as influenced by substrate properties and the hydrologic characteristics at each site. This robust classification system has been successfully applied throughout the United States and its Territories since the mid-1970s, making it a truly national system.

1.2.1 Exemptions to the FGDC Wetlands Classification Standard

Circumstances under which the FGDC Wetlands Classification Standard is *not* required include the following:

1. Wetlands inventory mapping activities that are not federally-funded. However, such projects are strongly encouraged to comply with the WCS. The builders of the NSDI will not incorporate non-compliant wetlands inventory data from any source except USFWS wetlands maps created prior to implementation of the Wetlands Mapping Standard (FGDC-STD-015- 2009).

2. Mapping designed, or intended, to support legal, regulatory, or jurisdictional analyses by Federal, Tribal, state, and local regulatory agencies or to differentiate between regulatory and non-regulatory wetlands.

3. Marine and estuarine benthic habitat mapping because it currently necessitates the use of definitions and classifications that differ from the WCS.

4. Classification data developed during site-specific wetland studies for scientific research, environmental assessments (EA), environmental impact statements (EIS), and wetland determinations for regulatory purposes when these site-specific activities necessitate the use of definitions and classifications that are incompatible with the WCS. However, the use of the WCS is strongly encouraged for these types of studies, whenever possible, so that the results can be interpolated or extrapolated across the country.

1.2.2 Coordination with FGDC Coastal and Marine Ecological Classification Standard

The FGDC Wetlands Classification Standard (WCS; FGDC-STD-004-2013) will be used to map all nontidal deepwater habitats except for the Great Lakes, and all coastal and inland wetlands except for permanently flooded tidal freshwater wetlands. The Coastal and Marine Ecological Classification Standard (CMECS; FGDC-STD-018-2012) will be used to map deepwater habitats in the Great Lakes and in the Marine and Estuarine Systems, as well as all permanently flooded tidal freshwater habitats (deepwater and wetland). The WCS will use 0.5 parts per thousand (ppt) ocean-derived salinity as the upstream boundary for the Estuarine System, and CMECS will use head-of-tide.

1.3 Applicability

The FGDC Wetlands Classification Standard is intended for all Federal or federally-funded wetlands inventory mapping including those activities conducted by Federal agencies, states, and federally-recognized tribal entities, non-governmental organizations, universities, and others. Specifically, if Federal funding is used in support of wetlands inventory mapping activities, then use of this Standard is mandatory. The adoption of this Standard for all other wetlands inventory mapping efforts (non-federally funded) is strongly encouraged to maintain and expand the wetlands layer of the NSDI.

The FGDC Wetlands Classification Standard is neither designed, nor intended, to support legal, regulatory, or jurisdictional analyses of wetlands mapping products, nor does it attempt to differentiate between regulatory and non-regulatory wetlands. Federal, Tribal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than the FGDC Wetlands Classification Standard and the FGDC Wetlands Mapping Standard. There is no attempt to define the limits of proprietary jurisdiction of any Federal, Tribal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, Tribal, state, or local agencies concerning specified agency regulatory programs and jurisdictions that may affect such activities.

1.4 Related Standards

Related FGDC Standards:

Wetlands Mapping Standard, FGDC-STD-015-2009

Coastal and Marine Ecological Classification Standard, FGDC-STD-018-2012

Soil Geographic Data Standard, FGDC-STD-006

National Vegetation Classification Standard (Version 2), FGDC-STD-005-2008

Information Technology—Geographic Information Framework Data Content Standard, Part 5: Governmental unit and other geographic area boundaries, FGDC-STD-014.5-2008

FGDC Standards are available at: http://www.fgdc.gov/

Other Related Practices:

A System for Mapping Riparian Areas in the Western United States (Dick 2009), http://www.fws.gov/wetlands/Documents/A-System-for-Mapping-Riparian-Areas-In-The-Western-United-States-2009.pdf See further documentation on riparian area standards at http://www.fws.gov/stand/standards/dl_riparian_WWW.html

Primary Indicators Method. Tiner, R. W. 1993. The primary indicators method—a practical approach to wetland recognition and delineation in the United States. Wetlands 13(1): 50-64. (This method is typically used for verifying Service Wetland Database wetlands on the ground.) http://www.fws.gov/wetlands/Documents/The-Primary-Indicators-Method-A-Practical-Approach-to-Wetland-Recognition-and-Delineation-in-the-United-States.pdf

National Hydrography Dataset (NHD) maintained by the USGS, http://nhd.usgs.gov/

Canadian Wetland Inventory maintained by Agriculture and Agri-Food Canada (AAFC), http://www.wetkit.net/modules/1/showtool.php?tool_id=83

RAMSAR Classification for Wetland Type maintained by Convention on Wetlands (Ramsar, Iran, 1971), http://www.ramsar.org/cda/ramsar/display/main/main.jsp?zn=ramsar&cp=1-26-76%5E21235_4000_0__

Guidance for Benthic Habitat Mapping: An Aerial Photographic Approach maintained by the NOAA Coastal Services Center, http://www.csc.noaa.gov/benthic/mapping/pdf/bhmguide.pdf

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia, http://www.natureserve.org/library/usEcologicalsystems.pdf

1.5 Standards Maintenance Procedures

The intent of the FGDC Wetlands Subcommittee was to produce a newly edited and updated version of the FGDC Wetlands Classification Standard (FGDC-STD-004-1996), *Classification of Wetlands and Deepwater Habitats of the United States* (originally authored by Cowardin et al. 1979). This revised Standard has been formatted to be consistent with more recently endorsed FGDC Standards. The text has been edited, refined, clarified, and rewritten as necessary. Some portions were rewritten because the scientific foundation upon which the original classification (Cowardin et al. 1979) was developed has advanced. The Wetlands Mapping Standard FGDC-STD-015-2009, also developed by the FGDC Wetlands Subcommittee, was endorsed by the FGDC in July of 2009. NWI's *Data Collection Requirements and Procedures for Mapping Wetland, Deepwater, and Related Habitats of the United States* (Dahl et al. 2009) will be revised as necessary to keep pace with advances in technology.

1.6 Maintenance Authority

The maintenance authority resides with the USFWS. Pertinent enabling authority resides in the Emergency Wetlands Resources Act of 1986. The USFWS has designated its NWI Project to undertake the responsibilities to satisfy the requirements of Circular A-16. In carrying out Federal Government-wide leadership in spatial wetlands data coordination, the USFWS is directly responsible to the FGDC, and the NWI ensures compliance with the objectives and guidance provided by the FGDC.

2. Wetlands and Deepwater Habitats

2.1 Concepts and Definitions

The definitions used in the FGDC Wetlands Classification Standard are neither designed, nor intended, to support legal, regulatory, or jurisdictional analyses of wetlands and deepwater habitats, nor do they attempt to differentiate between regulatory and non-regulatory wetlands or waters.

Marshes, swamps, and bogs have been well-known terms for centuries, but only since the mid-1970s have attempts been made to group these landscape units under the single term "wetlands." This general term has grown out of a need to understand and describe the characteristics and values of all types of land, and to effectively manage wetland habitats. There is no single, correct, indisputable, ecologically sound definition for wetlands, primarily because of the diversity of wetlands and because the demarcation between dry and wet environments lies along a continuum or gradient. Because reasons or needs for defining wetlands also vary, multiple definitions and criteria have been developed for different purposes. The primary purpose of this classification is to identify and describe wet habitats to aid in their inventory, assessment, and management. The definition used in this classification is habitat-based and amenable to remote sensing technology.

2.1.1 Wetlands

In general terms, wetlands are lands where saturation with water is the dominant factor determining the nature of substrate development and the types of plant and animal communities living in the substrate and on its surface. The single feature that most wetlands share is a substrate that is at least periodically saturated with or covered by water. The water creates severe physiological problems for all plants and animals except those that are specially adapted for such conditions.

Wetland "substrates" consist of unconsolidated mineral material, organic material, or rock that is flooded or saturated long enough each year to support wetland organisms (see glossary in Appendix A). Most wetland substrates also qualify as "soil." According to the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), "soil" is a natural body that occurs at the land surface and has recognizable horizons, or layers, or has the ability to support rooted plants (Soil Survey Staff 1999; see Appendix A for a more detailed technical definition). As noted, the great majority of wetlands have soil; obvious exceptions include bedrock and boulder or cobble shores which lack horizons and have too little fine material to support rooted plants. In this classification, the term "soil" is only used for wetland substrates that meet the USDA definition. The more generic term "substrate" may be applied to *any* wetland, but is most often used in this classification when referring to nonvegetated habitats and when defining terms (e.g., individual Water Regimes and Marine and Estuarine Subsystems) that apply to, or include, both habitats that have soil and habitats that do not.

The following definition of wetlands is neither designed, nor intended, to support legal, regulatory, or jurisdictional analyses, nor does it attempt to differentiate between regulatory and non-regulatory wetlands.

The FGDC Wetlands Classification Standard (WCS) defines "wetlands" according to Cowardin et al. (1979):

WETLANDS *are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes*[1]*; (2)*

[1] Lichvar, R. W., and J. T. Kartesz. 2009. North American Digital Flora: National Wetland Plant List, version 2.4.0 U.S. Army Corps of Engineers, Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire, and BONAP, Chapel Hill, North Carolina

the substrate is predominantly undrained hydric soil[2]*; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year*.

As noted in this definition, plant community composition, soil morphology, and site wetness (hydrology) are the principal indicators of whether a site is a wetland for ecological purposes. Site wetness, i.e., the presence of water, while central to the concept of wetland, is often the most difficult indicator to assess accurately because it is more dynamic (temporally variable) than plant community composition or soil properties. Plants and soil tend to reflect the prevailing degree of wetness at a site over time. For this reason, they frequently are excellent indicators of relative wetness, and this is why they are listed first as indicators of wetlands.

Cowardin et al. (1979) intended that *all available information* should be used in making a wetland identification, as follows:

- If plants and soil are present at a site, then both a predominance of hydrophytes and a predominance of undrained hydric soil, as well as wetland hydrology, should be required for positive wetland identification.
- If plants are present but soil is absent (e.g., Algal Aquatic Beds on rock substrates), then a predominance of hydrophytic vegetation, as well as wetland hydrology, should be required for a positive wetland identification.
- If plants are absent but soil is present, then a predominance of undrained hydric soil, as well as wetland hydrology, should be required for positive wetland identification.
- If neither plants nor soil is present, then the wetland identification must be made strictly on the basis of hydrology. In this case, the substrate should be "saturated with water or covered by shallow water at some time during the growing season of each year." Cowardin et al. (1979) fully realized how vague this hydrologic definition was but, given the lack of detailed hydrologic data from the diversity of wetland types, geologic regions, and climatic regions of the U.S., there was no way they could have been more specific. Even today, these data are not readily available across the nation.

In these examples, three (3) indicators – hydrophytic vegetation, undrained hydric soil, and wetland hydrology; two (2) indicators—hydrophytic vegetation and wetland hydrology or undrained hydric soil and wetland hydrology; and one (1) indicator—wetland hydrology, respectively, would be used to make the identification, based on the features available at the particular site.

[2] U.S. Department of Agriculture, Natural Resources Conservation Service. 2010. Field indicators of hydric soils in the United States. Version 7. L.M. Vasilas, G.W. Hunt, and C.V. Noble, eds. USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils.

2.1.2 Deepwater Habitats

DEEPWATER HABITATS *are permanently flooded lands lying below the deepwater boundary of wetlands* (see Section 2.2 for explanation of wetland limits). Deepwater habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium within which the dominant organisms live, whether or not they are rooted in, or attached to, the substrate. As in wetlands, the dominant plants are hydrophytes.

Wetlands and deepwater habitats are defined separately because traditionally the term wetlands has not included deep, permanent water; however, both must be considered in an ecological approach to classification. The WCS includes five major Systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats.

2.2 Limits

The upland limit of wetlands is characterized by (1) the boundary between land with predominantly hydrophytic cover and land with predominantly mesophytic or xerophytic cover; (2) the boundary between soil that is predominantly hydric and soil that is predominantly nonhydric; and (3) the boundary between land that is flooded or saturated at some time during the growing season each year and land that is not.

The boundary between wetlands and deepwater habitats in the Marine and Estuarine Systems coincides with the elevation of the extreme low water of spring tide; all permanently flooded areas are considered deepwater habitats in these Systems. The boundary between wetlands and deepwater habitat in the Riverine and Lacustrine Systems lies at a depth of 2.5 m (8.2 ft) below low water; however, if emergents, shrubs, or trees grow beyond this depth at any time, their deepwater edge is the boundary.

The 2.5-m lower limit for inland wetlands was selected because it approximates the maximum depth to which emergent plants normally grow (Welch 1952, Zhadin and Gerd 1963, Sculthorpe 1967) and the depth beyond which soil does not occur, according to the USDA Natural Resources Conservation Service (Soil Survey Staff 1999). As Daubenmire (1968:138) stated, emergents are not true aquatic plants, but are “amphibious,” growing in both permanently flooded and wet, nonflooded soils.

3. The Classification System

The structure of this classification is hierarchical, progressing from Systems and Subsystems at the most general levels to Classes, Subclasses, and Dominance Types. Figure 1 illustrates the classification structure through the Class level. Table 1 lists the Subclasses that occur within each System, Subsystem and Class. Modifiers for Water Regime, Water Chemistry, and Soil are applied to Classes and Subclasses. Special Modifiers describe wetlands and deepwater habitats that have been either created or highly modified by humans or beaver.

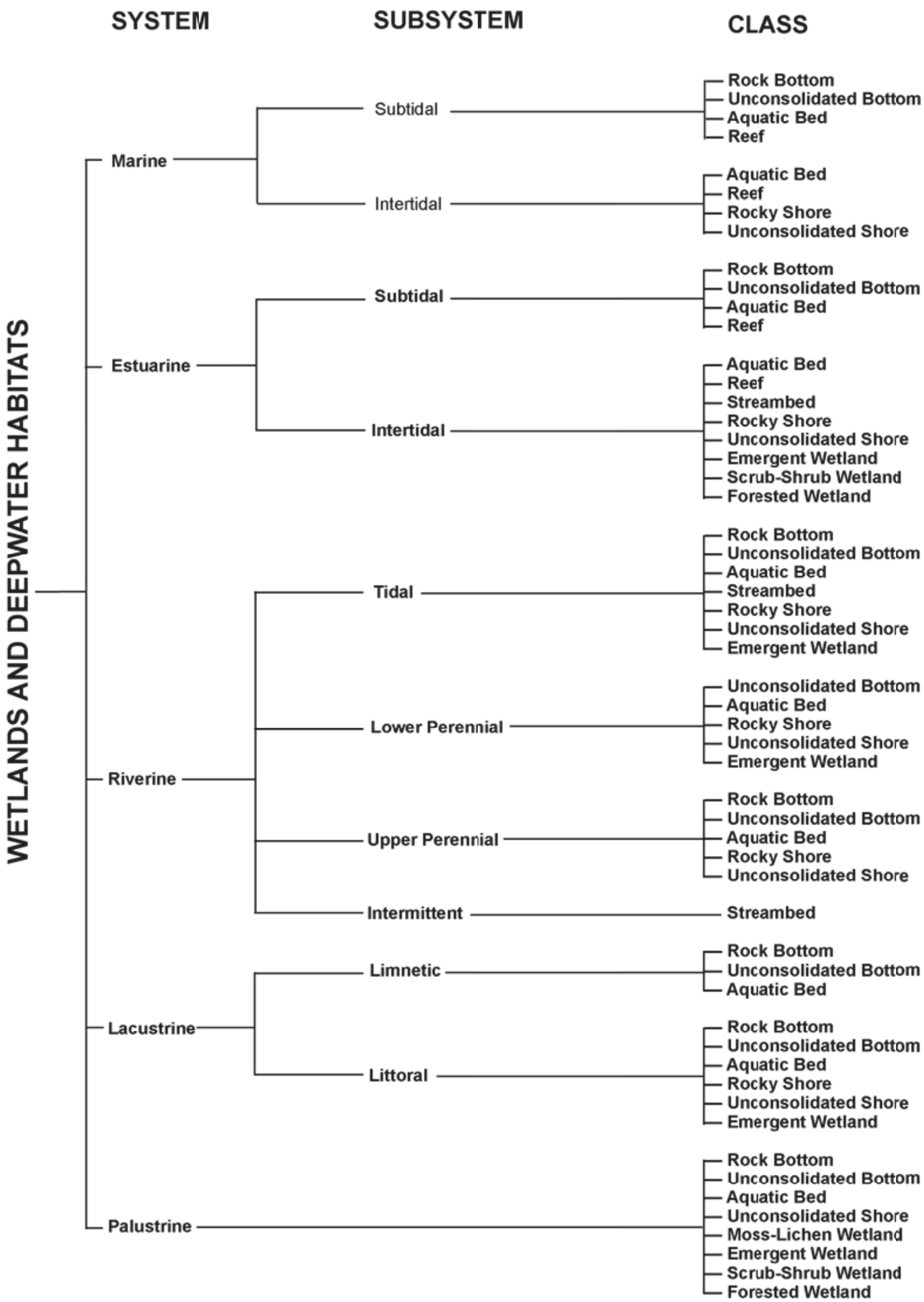

Figure 1. Classification hierarchy of wetlands and deepwater habitats, showing Systems, Subsystems, and Classes. The Palustrine System does not include deepwater habitats.

Table 1. Distribution of Subclasses within the classification hierarchy

	Systems and Subsystems										
	Marine		Estuarine		Riverine				Lacustrine		Palustrine
Classes and Subclasses	ST	IT	ST	IT	TI	LP	UP	IN	LM	LT	–
Rock Bottom											
Bedrock	✓		✓		✓		✓		✓	✓	✓
Rubble	✓		✓		✓		✓		✓	✓	✓
Unconsolidated Bottom											
Cobble-Gravel	✓		✓		✓	✓	✓		✓	✓	✓
Sand	✓		✓		✓	✓	✓		✓	✓	✓
Mud	✓		✓		✓	✓	✓		✓	✓	✓
Organic			✓		✓	✓			✓	✓	✓
Aquatic Bed											
Algal	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Aquatic Moss					✓	✓	✓		✓	✓	✓
Rooted Vascular	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Floating Vascular			✓	✓	✓	✓	✓		✓	✓	✓
Reef											
Coral	✓	✓									
Mollusk			✓	✓							
Worm	✓	✓	✓	✓							
Streambed											
Bedrock				✓	✓			✓			
Rubble				✓	✓			✓			
Cobble-Gravel				✓	✓			✓			
Sand				✓	✓			✓			
Mud				✓	✓			✓			
Organic				✓	✓			✓			
Vegetated (pioneer plants)								✓			
Rocky Shore											
Bedrock		✓		✓	✓	✓	✓			✓	
Rubble		✓		✓	✓	✓	✓			✓	
Unconsolidated Shore											
Cobble-Gravel		✓		✓	✓	✓	✓			✓	✓
Sand		✓		✓	✓	✓	✓			✓	✓
Mud		✓		✓	✓	✓	✓			✓	✓
Organic		✓		✓	✓	✓	✓			✓	✓
Vegetated (pioneer plants)						✓	✓			✓	✓
Moss-Lichen Wetland											
Moss											✓
Lichen											✓
Emergent Wetland											
Persistent				✓							✓
Nonpersistent				✓	✓	✓				✓	✓
Scrub-Shrub Wetland											
Broad-leaved Deciduous				✓							✓
Needle-leaved Deciduous				✓							✓
Broad-leaved Evergreen				✓							✓
Needle-leaved Evergreen				✓							✓
Dead				✓							✓
Forested Wetland											
Broad-leaved Deciduous				✓							✓
Needle-leaved Deciduous				✓							✓
Broad-leaved Evergreen				✓							✓
Needle-leaved Evergreen				✓							✓
Dead				✓							✓

ST = Subtidal, IT = Intertidal, TI = Tidal, LP = Lower Perennial, UP = Upper Perennial, IN = Intermittent, LM = Limnetic, LT = Littoral

Artificial keys to the Systems and Classes are given in Appendix B. Scientific and common names of plants (Appendix C) are based on Lichvar and Kartesz (2009). Scientific and common names of animals (Appendix D) were taken from various sources cited in the text; no attempt has been made to resolve nomenclatorial problems where there is a taxonomic dispute. Many of the terms in this classification have various meanings, even in the scientific literature, and in some instances our use of terms is new. Therefore, we have provided a glossary (Appendix A) to guide the reader in our usage of terms.

3.1 Systems and Subsystems

The term SYSTEM refers here to a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors. We further subdivide Systems into more specific categories called SUBSYSTEMS.

The characteristics of the five major Systems—Marine, Estuarine, Riverine, Lacustrine, and Palustrine—have been discussed at length in the scientific literature and the concepts are well recognized; however, there is frequent disagreement as to which attributes should be used to bound the Systems in space. For example, both the limit of tidal influence and the limit of ocean-derived salinity have been proposed for bounding the upstream end of the Estuarine System (Caspers 1967). As Bormann and Likens (1969) pointed out, boundaries of ecosystems are defined to meet practical needs.

3.1.1 Marine System

Definition. The Marine System (Figure 2) consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the Water Regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30 parts per thousand (ppt), with little or no dilution except outside the mouths of estuaries. Shallow coastal indentations or bays without appreciable freshwater inflow, and coasts with exposed rocky islands that provide the mainland with little or no shelter from wind and waves, are also considered part of the Marine System because they generally support typical marine biota.

Limits. The Marine System extends from the outer edge of the continental shelf shoreward to one of three lines: (1) the landward limit of tidal inundation (extreme high water of spring tides), including the splash zone from breaking waves; (2) the seaward limit of wetland emergents, trees, or shrubs; or (3) the seaward limit of the Estuarine System, where this limit is determined by factors other than vegetation. Deepwater habitats lying beyond the seaward limit of the Marine System are outside the scope of the WCS.

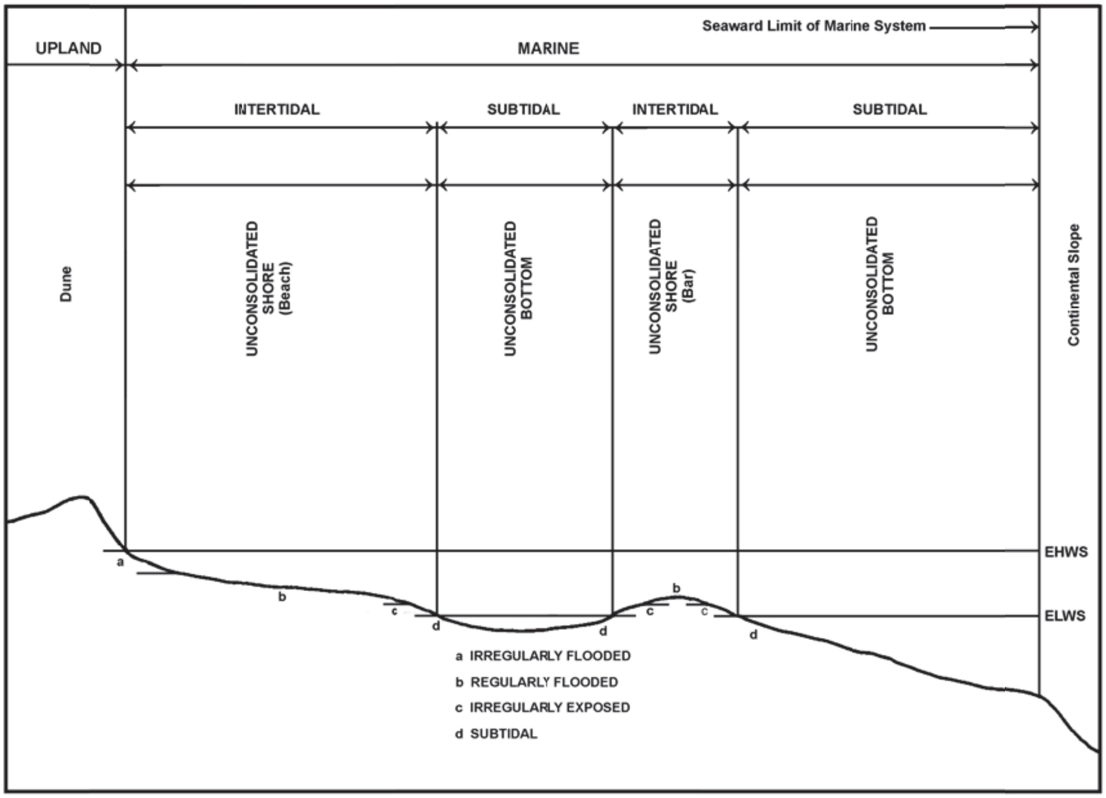

Figure 2. Distinguishing features and examples of habitats in the Marine System.
EHWS = extreme high water of spring tides; ELWS = extreme low water of spring tides.

Description. The distribution of plants and animals in the Marine System primarily reflects differences in four factors: (1) degree of exposure of the site to waves; (2) texture and physicochemical nature of the substrate; (3) amplitude of the tides; and (4) latitude, which governs water temperature, the intensity and duration of solar radiation, and the presence or absence of ice.

Subsystems.

Subtidal. The substrate in these habitats is continuously covered with tidal water (i.e., located below extreme low water).

Intertidal. The substrate in these habitats is flooded and exposed by tides; includes the associated splash zone.

Classes. Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Reef, Rocky Shore, and Unconsolidated Shore.

3.1.2 Estuarine System

Definition. The Estuarine System (Figure 3) consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semienclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. Along some low-energy coastlines there is appreciable dilution of sea water. Offshore areas with typical estuarine plants and animals, such as red mangroves (*Rhizophora mangle*) and eastern oysters (*Crassostrea virginica*), are also included in the Estuarine System.[3]

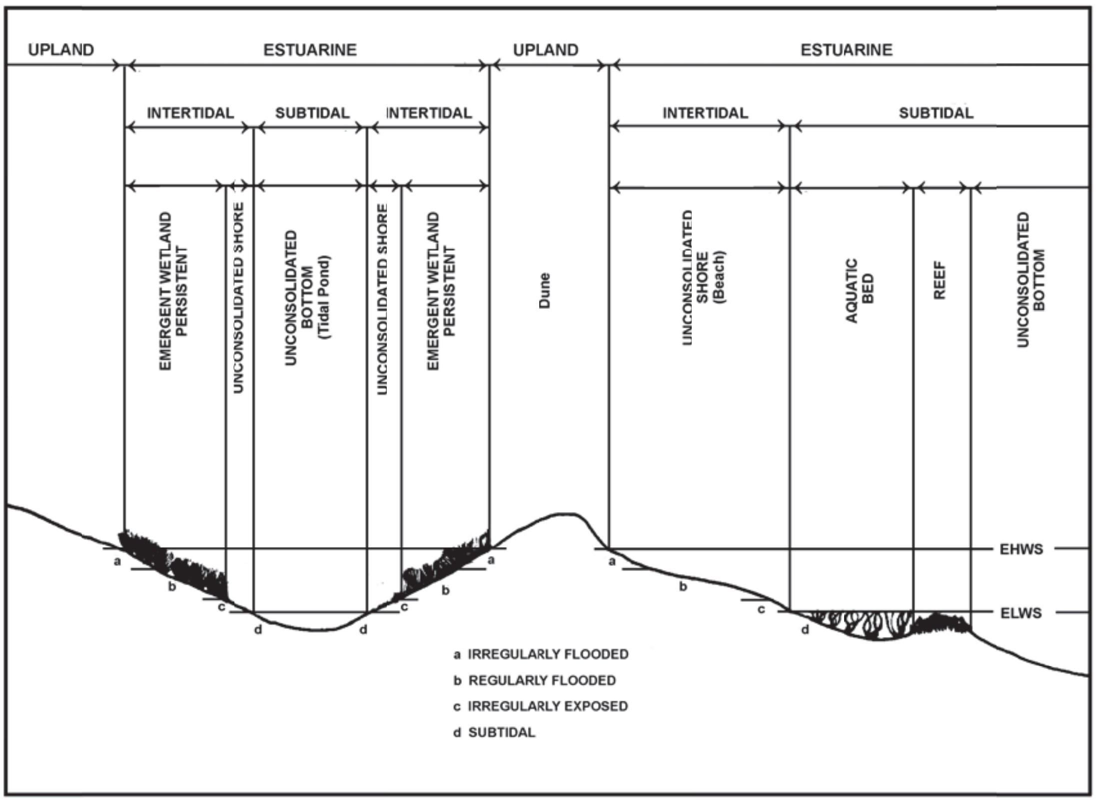

Figure 3. Distinguishing features and examples of habitats in the Estuarine System.
EHWS = extreme high water of spring tides; ELWS = extreme low water of spring tides.

Limits. The Estuarine System extends (1) upstream and landward to where ocean-derived salts measure less than 0.5 ppt during the period of average annual low flow; (2) seaward to an imaginary line closing the mouth of a river, bay, or sound; and (3) to the seaward

[3] The Coastal Zone Management Act of 1972 defines an estuary as "that part of a river or stream or other body of water having unimpaired connection with the open sea, where the sea-water is measurably diluted with freshwater derived from land drainage." The Act further states that "the term includes estuary-type areas of the Great Lakes." However, in the WCS we do not consider areas of the Great Lakes as Estuarine.

limit of wetland emergents, shrubs, or trees where they are not included in (2). The Estuarine System also includes offshore areas of continuously diluted sea water.

Description. The Estuarine System includes both estuaries and lagoons. It is more strongly influenced by its association with land than is the Marine System. In terms of wave action, estuaries are generally considered to be low-energy systems (Chapman 1977).

Estuarine water regimes and water chemistry are affected by one or more of the following forces: oceanic tides, precipitation, freshwater runoff from land areas, evaporation, and wind. Estuarine salinities range from hyperhaline to oligohaline (see Section 3.3.2.1 for Salinity Modifiers). The salinity may be variable, as in hyperhaline lagoons (e.g., Laguna Madre, Texas) and most estuaries (e.g., Chesapeake Bay, Virginia-Maryland); or it may be relatively stable, as in sheltered euhaline embayments (e.g., Chincoteague Bay, Maryland) or embayments with partly obstructed access or small tidal range (e.g., Pamlico Sound, North Carolina). (For an extended discussion of estuaries and lagoons, see Lauff 1967.)

Subsystems.

Subtidal. The substrate in these habitats is continuously covered with tidal water (i.e., located below extreme low water).

Intertidal. The substrate in these habitats is flooded and exposed by tides; includes the associated splash zone.

Classes. Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Reef, Streambed, Rocky Shore, Unconsolidated Shore, Emergent Wetland, Scrub-Shrub Wetland, and Forested Wetland.

3.1.3 Riverine System

Definition. The Riverine System (Figure 4) includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts of 0.5 ppt or greater. A channel is “an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water” (Langbein and Iseri 1960:5).

Limits. The Riverine System is bounded on the landward side by upland, by the channel bank (including natural and man-made levees), or by wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. In braided streams, the System is bounded by the banks forming the outer limits of the depression within which the braiding occurs.

The Riverine System terminates at the downstream end where the concentration of ocean-derived salts in the water equals or exceeds 0.5 ppt during the period of annual average low flow, or where the channel enters a lake. It terminates at the upstream end where tributary streams originate, or where the channel leaves a lake. Springs discharging into a channel are considered part of the Riverine System.

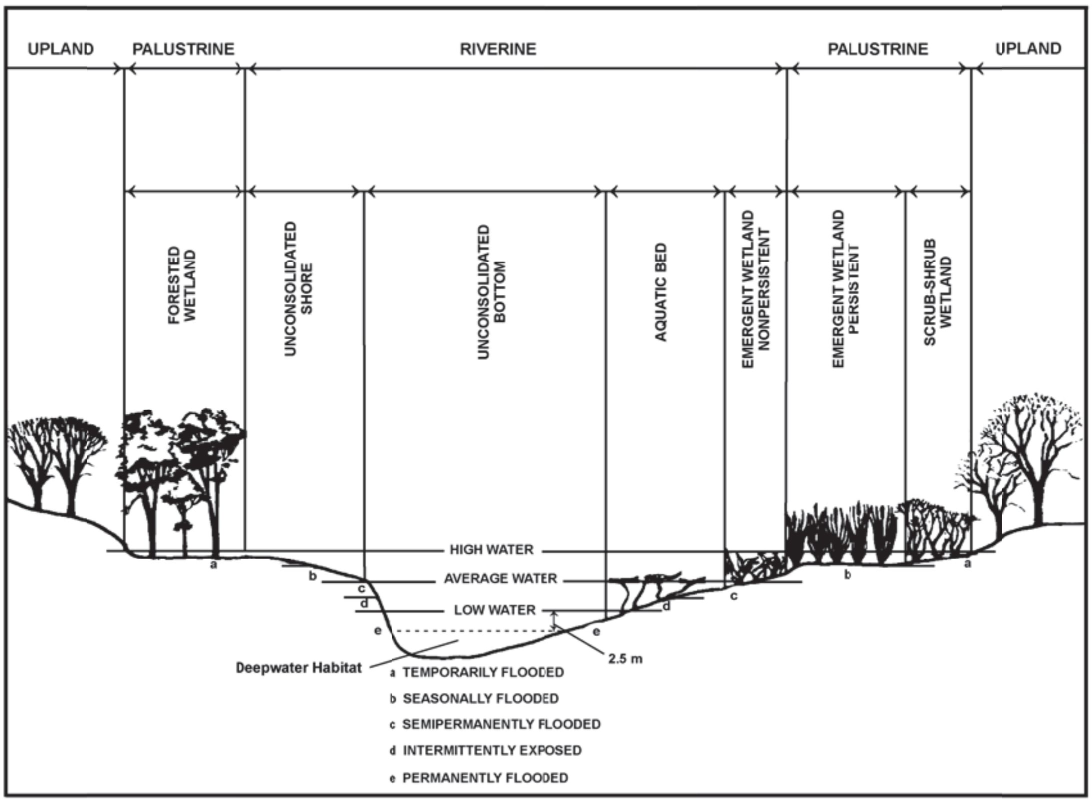

Figure 4. Distinguishing features and examples of habitats in the Riverine System.

Description. Water is usually, but not always, flowing in the Riverine System. Upland islands or Palustrine wetlands may occur in the channel, but they are not included in the Riverine System. Palustrine Moss-Lichen Wetlands, Emergent Wetlands, Scrub-Shrub Wetlands, and Forested Wetlands may occur adjacent to the Riverine System, often on a floodplain. Many biologists have suggested that all the wetlands occurring on the river floodplain should be a part of the Riverine System because they consider their presence to be the result of river flooding. However, this classification follows Reid and Wood (1976:72,84) who stated, "The floodplain is a flat expanse of land bordering an old river…. Often the floodplain may take the form of a very level plain occupied by the present stream channel, and it may never, or only occasionally, be flooded…. It is this subsurface water (the groundwater) that controls to a great extent the level of lake surfaces, the flow of streams, and the extent of swamps and marshes."

Subsystems. The Riverine System is divided into four Subsystems: the Tidal, the Lower Perennial, the Upper Perennial, and the Intermittent. Each is defined in terms of water permanence, gradient, substrate, and the extent of floodplain development. The Subsystems have characteristic flora and fauna (see Illies and Botosaneau 1963; Hynes 1970; Reid and Wood 1976). All four Subsystems are not necessarily present in all rivers, and the order of occurrence may be other than that given below.

Tidal. This Subsystem extends from the upstream limit of tidal fluctuations down to the upper boundary of the Estuarine System, where the concentration of ocean-derived salts reaches 0.5 ppt during the period of average annual low flow. The gradient is low and water velocity fluctuates under tidal influence. The stream bottom is mainly mud with occasional patches of sand. Oxygen deficits may sometimes occur and the fauna is similar to that in the Lower Perennial Subsystem. The floodplain is typically well developed.

Lower Perennial. This Subsystem is characterized by a low gradient. There is no tidal influence, and some water flows all year, except during years of extreme drought. The substrate consists mainly of sand and mud. Oxygen deficits may sometimes occur. The fauna is composed mostly of species that reach their maximum abundance in still water, and true planktonic organisms are common. The gradient is lower than that of the Upper Perennial Subsystem and the floodplain is well developed.

Upper Perennial. This Subsystem is characterized by a high gradient. There is no tidal influence, and some water flows all year, except during years of extreme drought. The substrate consists of rock, cobbles, or gravel with occasional patches of sand. The natural dissolved oxygen concentration is normally near saturation. The fauna is characteristic of running water, and there are few or no planktonic forms. The gradient is high compared with that of the Lower Perennial Subsystem, and there is very little floodplain development.

Intermittent. This Subsystem includes channels that contain flowing water only part of the year. When the water is not flowing, it may remain in isolated pools or surface water may be absent.

Classes: Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Streambed, Rocky Shore, Unconsolidated Shore, and Emergent Wetland (nonpersistent).

3.1.4 Lacustrine System

Definition. The Lacustrine System (Figure 5) includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with 30 percent or greater areal coverage; and (3) total area of at least 8 hectares (ha) (20 acres). Similar wetlands and deepwater habitats totaling less than 8 ha are also included in the Lacustrine System if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin equals or exceeds 2.5 m (8.2 ft) at low water. Lacustrine waters may be tidal or nontidal, but ocean-derived salinity is always less than 0.5 ppt.

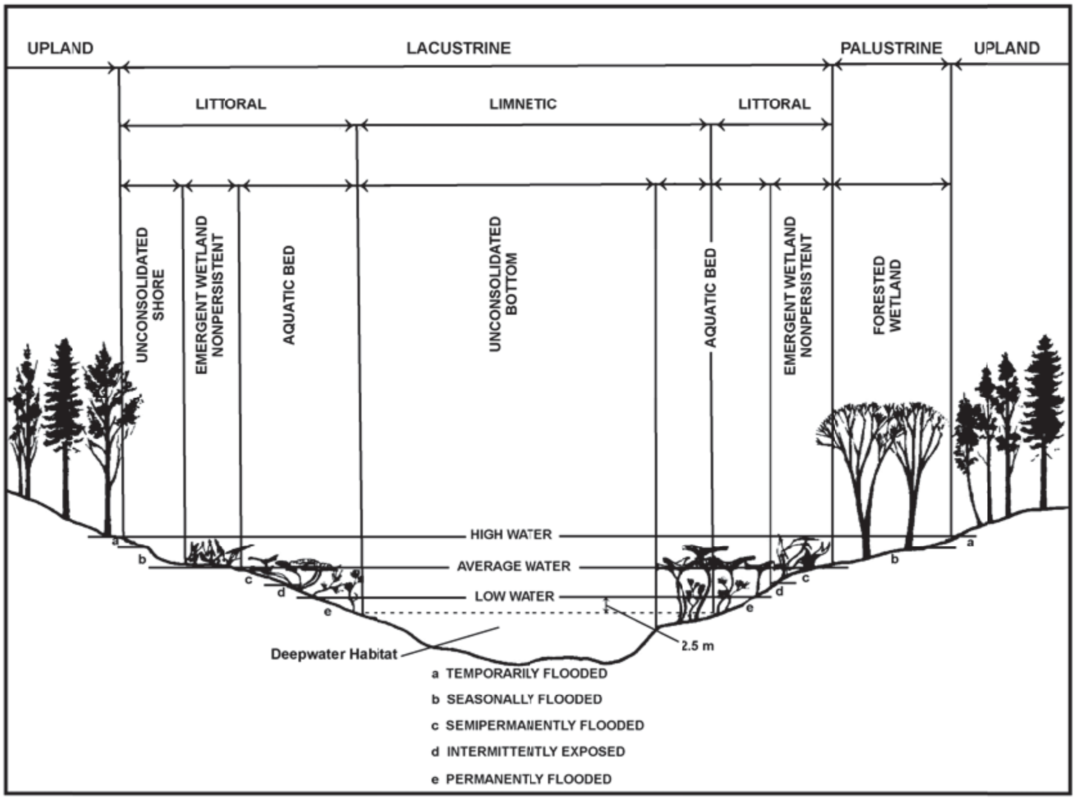

Figure 5. Distinguishing features and examples of habitats in the Lacustrine System.

Limits. The Lacustrine System is bounded by upland or by wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. Lacustrine Systems formed by damming a river channel are bounded by a contour approximating the normal spillway elevation or normal pool elevation, except where Palustrine wetlands extend lakeward of that boundary. Where a river enters a lake, the extension of the Lacustrine shoreline forms the Riverine-Lacustrine boundary.

Description. The Lacustrine System includes permanently flooded lakes and reservoirs (e.g., Lake Superior), intermittent lakes (e.g., playa lakes), and tidal lakes with ocean-derived salinities below 0.5 ppt (e.g., Grand Lake, Louisiana). Typically, there are extensive areas of deep water and there is considerable wave action. Islands of Palustrine wetlands may lie within the boundaries of the Lacustrine System.

Subsystems.
Limnetic. This subsystem includes all deepwater habitats (i.e., areas $\geq$ 2.5 m [8.2 ft] deep below low water) in the Lacustrine System. Many small Lacustrine Systems have no Limnetic Subsystem.

Littoral. This subsystem includes all wetland habitats in the Lacustrine System. It extends from the shoreward boundary of the System to a depth of 2.5 m (8.2 ft) below low water, or to the maximum extent of nonpersistent emergents if these grow at depths greater than 2.5 m.

Classes: Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Rocky Shore, Unconsolidated Shore, and Emergent Wetland (nonpersistent).

3.1.5 Palustrine System

Definition. The Palustrine System (Figure 6) includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ppt. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2.5 m (8.2 ft) at low water; and (4) salinity due to ocean-derived salts less than 0.5 ppt.

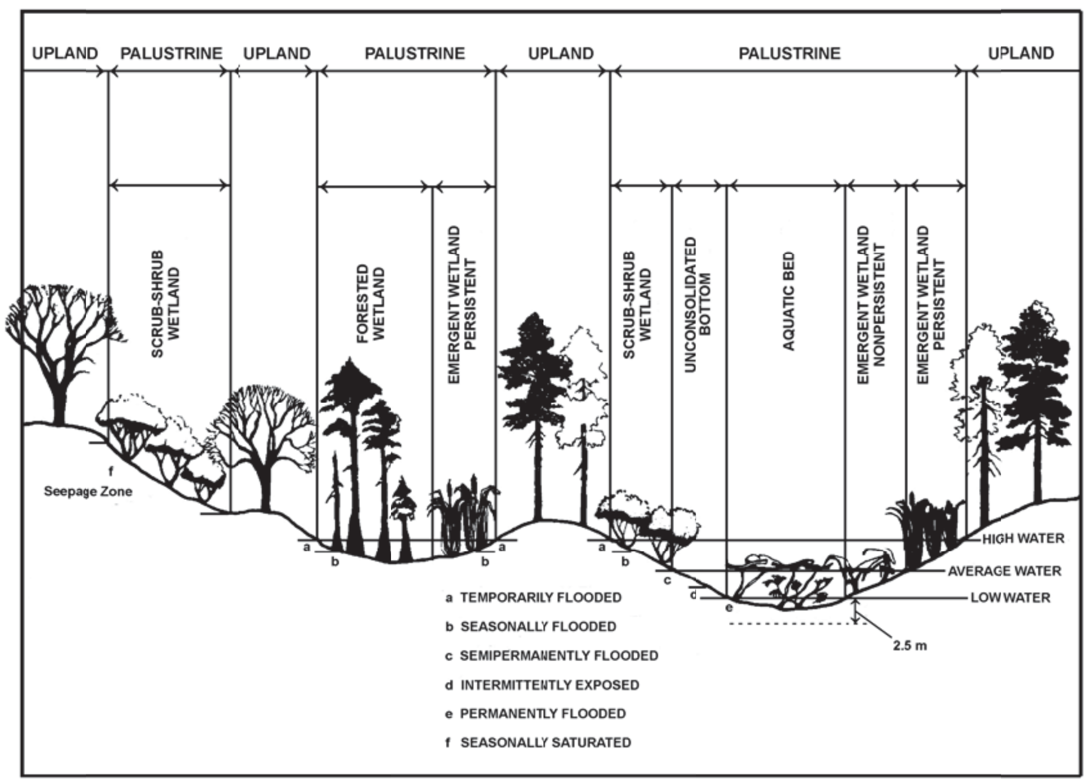

Figure 6. Distinguishing features and examples of habitats in the Palustrine System.

Limits. The Palustrine System is bounded by upland or by any of the other four Systems.

Description. The Palustrine System was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie, which are found throughout the U.S. It also includes the small, shallow, permanent or intermittent water bodies often called ponds. Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries; on river floodplains; in isolated catchments; or on slopes. They may also occur as islands in lakes or rivers. The erosive forces of wind and water are of minor importance except during severe floods.

The emergent vegetation adjacent to rivers and lakes is often referred to as “the shore zone” or the “zone of emergent vegetation” (Reid and Wood 1976), and is generally considered separately from the river or lake. As an example, Hynes (1970:85) wrote in reference to riverine habitats, “We will not here consider the long list of emergent plants which may occur along the banks out of the current, as they do not belong, strictly speaking, to the running water habitat.” There are often great similarities between wetlands lying adjacent to lakes or rivers and isolated wetlands of the same Class in basins without open water.

Subsystems. None.

Classes: Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Unconsolidated Shore, Moss-Lichen Wetland, Emergent Wetland, Scrub-Shrub Wetland, and Forested Wetland.

3.2 Classes, Subclasses, and Dominance Types

The CLASS is the highest taxonomic unit below the Subsystem level. It describes the general appearance of the habitat in terms of either the dominant life form of the vegetation or the physiography and composition of the substrate—features that can be recognized without the aid of detailed environmental measurements. Vegetation is used at two different levels in the classification. The basic life form layers, from highest to lowest—trees, shrubs, emergents, emergent mosses or lichens, and surface plants or submergents—are used to define Classes because they are relatively easy to distinguish, do not change distribution rapidly, and have traditionally been used for classification of wetlands and habitat assessment.[4] Pioneer plants that colonize wetlands during dry periods, but disappear when surface water returns, are treated at the Subclass level because they are transient and may be mesophytes or xerophytes. Use of life forms at the Class level has two major advantages: (1) extensive biological knowledge is not required to distinguish between various life forms, and (2) many life forms can be readily identified on a variety of remote sensing products (e.g., Radforth 1962; Anderson et al. 1976).

[4] The initial attempts to use familiar terms such as marsh, swamp, bog, and meadow at the Class level were unsuccessful primarily because of wide discrepancies in the use of these terms in various regions of the United States. In an effort to resolve that difficulty, we based the Classes on the fundamental components (life form, water regime, substrate type, water chemistry) that give rise to such terms. This approach has greatly reduced the misunderstandings and confusion that result from the use of the familiar terms.

If living vegetation (except pioneer species) covers 30 percent or more of the substrate, we distinguish Classes on the basis of the life form of the plants that constitute the uppermost layer of vegetation and that possess an areal coverage 30 percent or greater. For example, an area with 50 percent areal coverage of trees over a shrub layer with a 60 percent areal coverage would be classified as Forested Wetland; an area with 20 percent areal coverage of trees over the same (60 percent) shrub layer would be classified as Scrub-Shrub Wetland. When trees or shrubs alone cover less than 30 percent of an area but in combination cover 30 percent or more, the wetland is assigned to the Class Scrub-Shrub. When trees and shrubs cover less than 30 percent of the area but the total cover of vegetation (except pioneer species) is 30 percent or greater, the wetland is assigned to the appropriate Class for the predominant life form below the shrub layer.

When the height of two or more plant life forms in an area is equal, and each covers 30 percent or more of the area, the Class is based on the life form that has the greater cover. If the cover of the life forms is equal, then the Class is based on the life form that is more persistent. If the life forms are equally persistent, then the Class is based on the life form that would normally be considered to be more advanced from a successional standpoint (e.g., shrub > emergent plant > emergent moss or lichen).

Finer distinctions in life forms are recognized at the SUBCLASS level. Subclasses are named on the basis of the specific life form with the greatest areal coverage. In Scrub-Shrub and Forested Wetlands, for example, most Subclasses are distinguished by leaf type (broad-leaved deciduous, needle-leaved deciduous, broad-leaved evergreen, and needle-leaved evergreen).

When an area is covered more or less uniformly by dead trees or dead shrubs—regardless of their abundance—and living vegetation covers less than 30 percent of that area, the site would be placed in either the Dead Forested Wetland Subclass or the Dead Scrub-Shrub Wetland Subclass, depending on whether dead trees or dead shrubs predominate. However, if living vegetation covers 30 percent or more of a stand of dead trees or shrubs, then the dominant life form, Class, and Subclass would be based on the living vegetation, using the rules outlined above.

If living vegetation covers less than 30 percent of the substrate, the physiography and composition of the substrate are the principal characteristics used to distinguish Classes. Substrate particle sizes include boulders, stones, cobbles, gravel, sand, silt, and clay (see Appendix A for definitions). Cowardin et al. (1979) employed these, alone or in combination, along with the term 'bedrock,' as Subclasses for nonvegetated wetlands and deepwater habitats.

The nature of the substrate reflects regional and local variations in geology and the influence of wind, waves, and currents on erosion and deposition of substrate materials. Bottoms, Shores, and Streambeds are separated on the basis of duration of inundation. In the Riverine, Lacustrine, and Palustrine Systems, Bottoms are submerged all or most of the time, whereas Streambeds and Shores are exposed much of the time. In the Marine and Estuarine Systems, Bottoms are Subtidal, whereas Streambeds and Shores are Intertidal. Bottoms, Shores, and Streambeds are further divided at the Class level on the basis of the important characteristic of rock versus unconsolidated substrate. Subclasses are based on finer distinctions in substrate material unless, as with Streambeds and Shores, pioneer plants (often mesophytes or xerophytes) cover 30 percent or more of the substrate; the Subclass then is simply "vegetated." Further detail as to the type of vegetation must be obtained at the level of Dominance Type. Reefs are a unique Class in which the substrate itself is composed primarily of living and dead animals. Subclasses of Reefs are designated on the basis of the type of organism that formed the reef.

The DOMINANCE TYPE is the taxonomic category subordinate to Subclass. Dominance Types are determined on the basis of dominant plant species (e.g., Jeglum et al. 1974), dominant sedentary or sessile animal species (e.g., Thorson 1957), or dominant plant and animal species (e.g., Stephenson and Stephenson 1972). A dominant plant species has traditionally meant one that has control over the community (Weaver and Clements 1938), and this plant is also usually the predominant species (Cain and Castro 1959). When the Subclass is based on life form, the Dominance Type is named for the dominant species or combination of species (codominants) in the same layer of vegetation used to determine the Subclass.[5] For example, a Needle-leaved Evergreen Forested Wetland with 70 percent areal cover of black spruce (*Picea mariana*) and 30 percent areal cover of American larch (*Larix laricina*) would be designated as a *Picea mariana* Dominance Type. When the relative abundance of codominant species is nearly equal, the Dominance Type consists of a combination of species names. For example, an Emergent Wetland with about equal areal cover of broad-leaf cattail (*Typha latifolia*) and hardstem bulrush (*Scirpus acutus*) would be designated a *Typha latifolia-Scirpus acutus* Dominance Type.

When the Subclass is based on substrate material, the Dominance Type is named for the predominant plant or sedentary or sessile macroinvertebrate species, without regard for life form. In the Marine and Estuarine Systems, sponges, alcyonarians, mollusks, crustaceans, worms, ascidians, and echinoderms may all be part of the community represented by the *Macoma balthica* Dominance Type. Sometimes it is necessary to designate two or more codominant species as a Dominance Type. Thorson (1957) recommended guidelines and suggested definitions for establishing community types and dominants on level bottoms.

3.2.1 Rock Bottom

Definition. The Class Rock Bottom includes all wetlands and deepwater habitats with substrates having an areal cover of stones, boulders, or bedrock 75 percent or greater and vegetative cover of less than 30 percent. Water Regimes are restricted to Subtidal, Permanently Flooded, Intermittently Exposed, Semipermanently Flooded, Permanently Flooded-Tidal Fresh, and Semipermanently Flooded-Tidal Fresh.

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[5] Percent areal cover is seldom measured in the application of the WCS, but the term must be defined in terms of area. We suggest 2 m^2 for herbaceous and moss layers, 16 m^2 for shrub layers, and 100 m^2 for tree layers (Mueller-Dombois and Ellenberg 1974). When percent areal cover is the key for establishing boundaries between units of the classification, it may occasionally be necessary to measure cover on plots, in order to maintain uniformity of ocular estimates made in the field or interpretations made from aerial photographs.

Description. The rock substrate of the rocky benthic or bottom zone is one of the most important factors in determining the abundance, variety, and distribution of organisms. The stability of the bottom allows a rich assemblage of plants and animals to develop. Rock Bottoms are usually high-energy habitats with well-aerated waters. Temperature, salinity, current, and light penetration are also important factors in determining the composition of the benthic community. Animals that live on the rocky surface are generally firmly attached by hooking or sucking devices, although they may occasionally move about over the substrate. Some may be permanently attached by cement. A few animals hide in rocky crevices and under rocks, some move rapidly enough to avoid being swept away, and others burrow into the finer substrates between boulders. Plants are also firmly attached (e.g., by hold-fasts), and in the Riverine System both plants and animals are commonly streamlined or flattened in response to high water velocities.

Subclasses and Dominance Types.

Bedrock. Bottoms in which bedrock covers 75 percent or more of the surface.

Rubble. Bottoms with less than 75 percent areal cover of bedrock, but stones and boulders alone, or in combination with bedrock, cover 75 percent or more of the surface.

Examples of Dominance Types for these two Subclasses in the Marine and Estuarine Systems are the encrusting sponges *Hippospongia*, the tunicate *Cnemidocarpa*, the sea urchin *Strongylocentrotus*, the sea star *Pisaster*, the sea whip *Muricea*, and the American lobster *Homarus americanus*. Examples of Lacustrine, Palustrine, and Riverine Dominance Types are the freshwater sponges *Spongilla* and *Heteromeyenia*, the pond snail *Lymnaea*, the mayfly *Ephemerella*, various midges of the Chironomidae, the caddisfly *Hydropsyche*, the leech *Helobdella*, the riffle beetle *Psephenus*, the chironomid midge *Eukiefferiella*, the crayfish *Procambarus*, and the black fly *Simulium*.

Dominance Types for Rock Bottoms in the Marine and Estuarine Systems were taken primarily from Smith (1964) and Ricketts and Calvin (1968), and those for Rock Bottoms in the Lacustrine, Riverine, and Palustrine Systems from Krecker and Lancaster (1933), Stehr and Branson (1938), Ward and Whipple (1959), Clarke (1973), Hart and Fuller (1974), Ward (1975), Slack et al. (1977), and Pennak (1978).

3.2.2 Unconsolidated Bottom

Definition. The Class Unconsolidated Bottom includes all wetlands and deepwater habitats with at least 25 percent cover of particles smaller than stones and a vegetative cover less than 30 percent. Water Regimes are restricted to Subtidal, Permanently Flooded, Intermittently Exposed, Semipermanently Flooded, Permanently Flooded-Tidal Fresh, and Semipermanently Flooded-Tidal Fresh.

Description. Unconsolidated Bottoms are characterized by the lack of large stable surfaces for plant and animal attachment. They are usually found in areas with lower energy than Rock Bottoms, and may be very unstable. Exposure to wave and current action, temperature, salinity, and light penetration determines the composition and distribution of organisms.

Most macroalgae attach to the substrate by means of basal hold-fast cells or discs; in sand and mud, however, algae penetrate the substrate and higher plants can successfully root if wave action and currents are not too strong. Most animals in unconsolidated sediments live within the substrate, e.g., *Macoma* and the amphipod *Melita*. Some, such as the polychaete worm *Chaetopterus*, maintain permanent burrows, and others may live on the surface, especially in coarse-grained sediments.

In the Marine and Estuarine Systems, Unconsolidated Bottom communities are relatively stable. They vary from the Arctic to the tropics, depending largely on temperature, and from the open ocean to the upper end of the estuary, depending on salinity. Thorson (1957) summarized and described characteristic types of level-bottom communities in detail.

In the Riverine System, the substrate type is largely determined by current velocity, and plants and animals exhibit a high degree of morphologic and behavioral adaptation to flowing water. Certain species are confined to specific substrates and some are at least more abundant in one type of substrate than in others. According to Hynes (1970:208), “The larger the stones, and hence the more complex the substratum, the more diverse is the invertebrate fauna.” In the Lacustrine and Palustrine Systems, there is usually a high correlation, within a given water body, between the nature of the substrate and the number of species and individuals. For example, in the profundal bottom of eutrophic lakes where light is absent, oxygen content is low, and carbon dioxide concentration is high, the sediments are ooze-like organic materials and species diversity is low. Each substrate type typically supports a relatively distinct community of organisms (Reid and Wood 1976).

Subclasses and Dominance Types.

Cobble-Gravel. The unconsolidated particles smaller than stones are predominantly cobbles and gravel, although finer sediments may be intermixed. Examples of Dominance Types for the Marine and Estuarine Systems are the mussels *Modiolus* and *Mytilus*, the brittle star *Amphipholis*, the soft-shell clam *Mya*, and the Venus clam *Saxidomus*. Examples for the Lacustrine, Palustrine, and Riverine Systems are the midge *Diamesa*, stonefly-midge *Nemoura-Eukiefferiella* (Slack et al. 1977), chironomid midge-caddisfly-snail *Chironomus-Hydropsyche-Physa* (Krecker and Lancaster 1933), the pond snail *Lymnaea*, the mayfly *Baetis*, the freshwater sponge *Eunapius*, the oligochaete worm *Lumbriculus*, the scud *Gammarus*, and the freshwater mollusks *Anodonta*, *Elliptio*, and *Lampsilis*.

Sand. The unconsolidated particles smaller than stones are predominantly sand, although finer or coarser sediments may be intermixed. Examples of Dominance Types in the Marine and Estuarine Systems are the wedge shell *Donax*, the scallop *Pecten*, the tellin shell *Tellina*, the heart urchin *Echinocardium*, the lugworm *Arenicola*, the sand dollar *Dendraster*, and the sea pansy *Renilla*. Examples for the Lacustrine, Palustrine, and

Riverine Systems are the snail *Physa*, the scud *Gammarus*, the oligochaete worm *Limnodrilus*, the mayfly *Ephemerella*, the freshwater mollusks *Elliptio* and *Anodonta*, and the fingernail clam *Sphaerium*.

Mud. The unconsolidated particles smaller than stones are predominantly silt and clay, although coarser sediments or organic material may be intermixed. Organisms living in mud must be able to adapt to low oxygen concentrations. Examples of Dominance Types for the Marine and Estuarine Systems include the terebellid worm *Amphitrite*, the boring clam *Platyodon*, the deep-sea scallop *Placopecten*, the quahog *Mercenaria*, the macoma *Macoma*, the echiurid worm *Urechis*, the mud snail *Nassarius*, and the sea cucumber *Thyone*. Examples of Dominance Types for the Lacustrine, Palustrine, and Riverine Systems are the sewage worm *Tubifex*, freshwater mollusks *Anodonta*, *Anodontoides*, and *Elliptio*, the fingernail clams *Pisidium* and *Sphaerium*, and the midge *Chironomus*.

Organic. The unconsolidated material smaller than stones is predominantly organic; there is no minimum depth requirement. The organic material is dead plant tissue in varying stages of decomposition. The number of species is limited and faunal productivity is very low (Welch 1952). Examples of Dominance Types for Estuarine and Marine Systems are the soft-shell clam *Mya*, the false angel wing *Petricola pholadiformis*, the clam worm *Nereis*, and the mud snail *Nassarius*. Examples for the Lacustrine, Palustrine, and Riverine Systems are the sewage worm *Tubifex*, the snail *Physa*, the harpacticoid copepod *Canthocamptus*, and the oligochaete worm *Limnodrilus*. Dominance Types for Unconsolidated Bottoms in the Marine and Estuarine Systems were taken predominantly from Miner (1950), Smith (1964), Abbott (1968), and Ricketts and Calvin (1968). Dominance Types for Unconsolidated Bottoms in the Lacustrine, Riverine, and Palustrine Systems were taken predominantly from Krecker and Lancaster (1933), Stehr and Branson (1938), Johnson (1970), Brinkhurst and Jamieson (1972), Clarke (1973), Hart and Fuller (1974), Ward (1975), and Pennak (1978).

3.2.3 Aquatic Bed

Definition. The Class "Aquatic Bed" includes wetlands and deepwater habitats where plants that grow principally on or below the surface of the water (i.e., surface plants or submergents) are the uppermost life form layer with at least 30 percent areal coverage. Water Regimes include Subtidal, Irregularly Exposed, Regularly Flooded, Permanently Flooded, Intermittently Exposed, Semipermanently Flooded, Seasonally Flooded, Seasonally Flooded-Saturated, Permanently Flooded-Tidal Fresh, Semipermanently Flooded-Tidal Fresh, and Seasonally Flooded-Tidal Fresh.

Description. Aquatic Beds represent a diverse group of plant communities that require surface water for optimum growth and reproduction. They include submerged or floating-leaved rooted vascular plants, free-floating vascular plants, submergent mosses, and algae. They are best developed in relatively permanent water or under conditions of repeated flooding. The plants are either attached to the substrate or float freely on, or beneath, the water surface.

Subclasses and Dominance Types.

Algal. In these Aquatic Beds, algae have the greatest areal coverage. Algal Beds are widespread and diverse in the Marine and Estuarine Systems, where they occupy substrates characterized by a wide range of sediment depths and textures. They occur in both the Subtidal and Intertidal Subsystems and may grow to depths of 30 m (98 ft). Coastal Algal Beds are most luxuriant along the rocky shores of the Northeast and West. Kelp (*Macrocystis*) beds are especially well developed on the rocky substrates of the Pacific Coast. Dominance Types such as the rockweeds *Fucus* and *Ascophyllum* and the kelp *Laminaria* are common along both coasts. In tropical regions, green algae, including forms containing calcareous particles, are more characteristic; *Halimeda* and *Penicillus* are common examples. The red alga *Laurencia*, and the green algae *Caulerpa*, *Enteromorpha*, and *Ulva* are also common Estuarine and Marine Dominance Types; *Enteromorpha* and *Ulva* are tolerant of fresh water and flourish near the upper end of some estuaries. The stonewort *Chara* also is found in estuaries.

Inland, the stoneworts *Chara*, *Nitella*, and *Tolypella* are examples of algae that look much like vascular plants and may grow in similar situations. However, meadows of *Chara* may be found in Lacustrine water as deep as 40 m (131 ft) (Zhadin and Gerd 1963), where hydrostatic pressure limits the survival of vascular submergents (phanaerogams) (Welch 1952). Other algae bearing less resemblance to vascular plants are also common. Mats of filamentous algae may cover the bottom in dense blankets, may rise to the surface under certain conditions, or may become stranded on Unconsolidated or Rocky Shores.

Aquatic Moss. In this Subclass, aquatic mosses have the greatest areal coverage. Aquatic mosses are far less common than algae or vascular plants. Aquatic Moss Beds occur primarily in the Riverine System and in Permanently Flooded and Intermittently Exposed parts of some Lacustrine systems. The most important Dominance Types include genera such as *Fissidens*, *Drepanocladus*, and *Fontinalis*. *Fontinalis* may grow to depths as great as 120 m (394 ft) (Hutchinson 1975). For simplicity, aquatic liverworts of the genus *Marsupella* are included in this Subclass.

Rooted Vascular. In this Subclass, rooted vascular plants have the greatest areal coverage. In the Marine and Estuarine Systems, Rooted Vascular Beds include a large array of species that grow primarily below water. They have been referred to by others as temperate grass flats (Phillips 1974); tropical marine meadows (Odum 1974); and eelgrass beds, turtlegrass beds, and seagrass beds (Akins and Jefferson 1973; Eleuterius 1973; Phillips 1974). The greatest number of species occurs in shallow, clear tropical, or subtropical waters of moderate current strength in the Caribbean and along the Florida and Gulf Coasts. Principal Dominance Types in these areas include turtlegrass (*Thalassia testudinum*), shoalgrass (*Halodule writghtii*), manatee grass (*Cymodocea filiformis*), widgeon grass (*Ruppia martima*), sea grasses (*Halophila* spp.), and wild celery (*Vallisneria americana*).

Five major vascular species dominate along the temperate coasts of North America: shoalgrass, surf grasses (*Phyllospadix scoulleri, P. torreyi*), widgeon grass, and eelgrass

(*Zostera marina*). Eelgrass beds have the most extensive distribution, but they are limited primarily to the more sheltered estuarine environment. In the lower salinity zones of estuaries, stands of widgeon grass, grassy pondweed (*Potamogeton*), and wild celery often occur, along with naiads (*Najas*) and water milfoil (*Myriophyllum*).

In the Riverine, Lacustrine, and Palustrine Systems, rooted vascular submergent plants occur at all depths within the photic zone. They often occur in sheltered areas where there is little water movement (Wetzel 1975); however, they also occur in the flowing water of the Riverine System, where they may be streamlined or flattened in response to high water velocities. Typical inland genera include pondweeds, horned pondweed (*Zannichellia palustris*), ditch grasses (*Ruppia*), wild celery, and waterweed (*Elodea*). The riverweed (*Podostemum ceratophyllum*) is included in this Class despite its lack of truly recognizable roots (Sculthorpe l967).

Some rooted vascular aquatic plants have floating leaves. Typical dominants include water lilies (*Nymphaea, Nuphar*), floating-leaf pondweed (*Potamogeton natans*), and water shield (*Brasenia schreberi*). Plants such as yellow water lily (*Nuphar luteum*) and water smartweed (*Polygonum amphibium*), which may stand erect above the water surface or substrate, may be considered either emergents or rooted vascular aquatic plants, depending on the life form adopted at a particular site.

Floating Vascular. In this Subclass, vascular plants that float freely on or below the water surface have the greatest areal coverage. Floating Vascular Beds occur mainly in the Lacustrine, Palustrine, and Riverine Systems and in the less saline waters of the Estuarine System. Dominant plants that float on the surface include the duckweeds (*Lemna, Spirodela*), water lettuce (*Pistia stratiotes*), common water hyacinth (*Eichhornia crassipes*), water chestnut (*Trapa natans*), water mosses (*Salvinia* spp.), and mosquito ferns (*Azolla* spp.). These plants are found primarily in protected portions of slow-flowing rivers and in the Lacustrine and Palustrine Systems. They are easily moved about by wind or water currents and cover a large area of water in some parts of the country, particularly the Southeast. Dominance Types for beds floating below the surface include bladderworts (*Utricularia*), coontails (*Ceratophyllum*), and watermeals (*Wolffia*) (Sculthorpe 1967; Hutchinson 1975).

3.2.4 Reef

Definition. The Class Reef includes ridge-like or mound-like structures formed by the colonization and growth of sedentary invertebrates. Water Regimes are restricted to Subtidal, Irregularly Exposed, Regularly Flooded, and Irregularly Flooded.

Description. Reefs are characterized by their elevation above the surrounding substrate and their interference with normal wave flow; they are primarily subtidal, but parts of some reefs may be intertidal as well. Although corals, oysters, and tube worms are the most visible organisms and are mainly responsible for reef formation, other mollusks, foraminifera, coralline algae, and other forms of life also contribute substantially to reef growth. Frequently, reefs contain far more dead skeletal material and shell fragments than living matter.

Subclasses and Dominance Types.

Coral. Coral Reefs are widely distributed in shallow waters of warm seas, in Hawaii, Puerto Rico, the Virgin Islands, and southern Florida. They were characterized by Odum (1971) as stable, well-adapted, highly diverse, and highly productive ecosystems with a great degree of internal symbiosis. Coral Reefs lie almost entirely within the Subtidal Subsystem of the Marine System, although the upper part of certain Reefs may be Intertidal. Examples of Dominance Types are the corals *Porites*, *Acropora*, and *Montipora*. The distribution of these types reflects primarily their elevation, wave exposure, the age of the Reef, and its exposure to waves.

Mollusk. This Subclass occurs in both the Intertidal and Subtidal Subsystems of the Estuarine System. These Reefs are found on the Pacific, Atlantic, and Gulf Coasts and in Hawaii and the Caribbean. Mollusk Reefs may become extensive, affording a substrate for sedentary and boring organisms and a shelter for many others. Reef mollusks are adapted to great variations in water level, salinity, and temperature, and these same factors control their distribution. Examples of Dominance Types for this Subclass are the oysters *Ostrea* and *Crassostrea* (Smith 1964; Abbott 1968; Ricketts and Calvin 1968).

Worm. Worm Reefs are constructed by large colonies of Sabellariid worms living in individual tubes constructed from cemented sand grains. Although they do not support as diverse a biota as do Coral and Mollusk Reefs, they provide a distinct habitat which may cover large areas. Worm Reefs are generally confined to tropical waters, and are most common along the coasts of Florida, Puerto Rico, and the Virgin Islands. They occur in both the Intertidal and Subtidal Systems of the Marine and Estuarine Systems where the salinity approximates that of sea water. The reef worm *Sabellaria* is an example of a Dominance Type for this Subclass (Ricketts and Calvin 1968).

3.2.5 Streambed

Definition. The Class Streambed includes all wetlands contained within the Intermittent Subsystem of the Riverine System and all channels of the Estuarine System or of the Tidal Subsystem of the Riverine System that are completely dewatered at low tide. Water Regimes are restricted to Irregularly Exposed, Regularly Flooded, Irregularly Flooded, Seasonally Flooded, Seasonally Flooded-Saturated, Temporarily Flooded, Intermittently Flooded, and Regularly Flooded-Tidal Fresh.

Description. Streambeds vary greatly in substrate and form depending on the gradient of the channel, the velocity of the water, and the sediment load. The substrate material frequently changes abruptly between riffles and pools, and complex patterns of bars may form on the convex side of single channels or be included as islands within the bed of braided streams (Crickmay 1974). In mountainous areas the entire channel may be cut through bedrock. In most cases streambeds are not vegetated because of the scouring effect of moving water, but, like Unconsolidated Shores, they may be colonized by “pioneer” annuals or perennials during periods of low flow or they may have perennial emergents and shrubs that are too scattered to qualify the area for classification as Emergent Wetland or Scrub-Shrub Wetland.

Subclasses and Dominance Types.

Bedrock. This Subclass is characterized by a bedrock substrate covering 75 percent or more of the stream channel. It occurs most commonly in the Riverine System in high mountain areas or in glaciated areas where bedrock is exposed. Examples of Dominance Types are the mollusk *Ancylus*, the oligochaete worm *Limnodrilus*, the snail *Physa*, the fingernail clam *Pisidium*, and the mayflies *Caenis* and *Ephemerella*.

Rubble. This Subclass is characterized by stones, boulders, and bedrock that, combined, cover 75 percent or more of the channel; however, bedrock alone covers less than 75 percent. Like Bedrock Streambeds, Rubble Streambeds are most common in mountainous areas and the dominant organisms are similar to those of Bedrock and are often forms capable of attachment to rocks in flowing water.

Cobble-Gravel. In this Subclass at least 25 percent of the substrate is covered by unconsolidated particles smaller than stones; cobbles or gravel predominate. The Subclass occurs in riffle areas or in the channels of braided streams. Examples of Dominance Types in the Intermittent Subsystem of the Riverine System are the snail *Physa*, the oligochaete worm *Limnodrilus*, the mayfly *Caenis*, the midge *Chironomus*, and the mosquito *Anopheles*. Examples of Dominance Types in the Estuarine System or Tidal Subsystem of the Riverine System are the mussels *Modiolus* and *Mytilus*.

Sand. In this Subclass, sand-sized particles predominate among the particles smaller than stones. Sand Streambed often contains bars and beaches interspersed with Mud Streambed or it may be interspersed with Cobble-Gravel Streambed in areas of fast flow or heavy sediment load. Examples of Dominance Types in the Riverine System are the scud *Gammarus*, the snails *Physa* and *Lymnaea*, and the midge *Chironomus*; in the Estuarine System the ghost shrimp *Callianassa* is a common Dominance Type.

Mud. In this Subclass, the particles smaller than stones are chiefly silt or clay. Mud Streambeds are common in arid areas where intermittent flow is characteristic of streams of low gradient. Such species as tamarisk (*Tamarix gallica*) may occur, but are not dense enough to qualify the area for classification as Scrub-Shrub Wetland. Mud Streambeds are also common in the Estuarine System and the Tidal Subsystem of the Riverine System. Examples of Dominance Types for Mud Streambeds include the crayfish *Procambarus*, the pouch snail *Aplexa*, the fly *Tabanus*, the snail *Lymnaea*, the fingernail clam *Sphaerium*, and (in the Estuarine System) the mud snail *Nassarius*.

Organic. This Subclass is characterized by channels formed in peat or muck. Organic Streambeds are common in the small creeks draining Estuarine Emergent Wetlands with organic soils. Examples of Dominance Types are the mussel *Modiolus* in the Estuarine System and the oligochaete worm *Limnodrilus* in the Riverine System.

Vegetated. These Streambeds are exposed long enough to be colonized by pioneer plants that, unlike Emergent Wetland plants or Scrub-Shrub Wetland plants, are usually killed by rising water levels. Many of the pioneer species are weedy mesophytes or xerophytes.

At least 30 percent cover of pioneer plants is required. Common panic grass (*Panicum capillare*) is a typical Dominance Type in the Riverine System.

Dominance Types for Streambeds in the Estuarine System were taken primarily from Smith (1964), Abbott (1968), and Ricketts and Calvin (1968) and those for streambeds in the Riverine System from Krecker and Lancaster (1933), Stehr and Branson (1938), van der Schalie (1948), Kenk (1949), Cummins et al. (1964), Clarke (1973), and Ward (1975).

3.2.6 Rocky Shore

Definition. The Class Rocky Shore includes wetland habitats characterized by bedrock, stones, or boulders which singly or in combination have an areal cover of 75 percent or more and an areal coverage by vegetation of less than 30 percent. Water Regimes are restricted to Irregularly Exposed, Regularly Flooded, Irregularly Flooded, Seasonally Flooded, Seasonally Flooded-Saturated, Temporarily Flooded, Intermittently Flooded, Regularly Flooded-Tidal Fresh, Seasonally Flooded-Tidal Fresh, and Temporarily Flooded-Tidal Fresh.

Description. In Marine and Estuarine Systems, Rocky Shores are generally high-energy habitats that lie exposed as a result of continuous erosion by wind-driven waves or strong currents. The substrate is stable enough to permit the attachment and growth of sessile or sedentary invertebrates and attached algae or lichens. Rocky Shores usually display a vertical zonation that is a function of tidal range, wave action, and degree of exposure to the sun. In the Lacustrine and Riverine Systems, Rocky Shores support sparse plant and animal communities.

Subclasses and Dominance Types.

Bedrock. These wetlands have bedrock covering 75 percent or more of the surface and less than 30 percent areal coverage of macrophytes.

Rubble. These wetlands have less than 75 percent areal cover of bedrock, but stones and boulders alone or in combination with bedrock cover 75 percent or more of the area. The areal coverage of macrophytes is less than 30 percent.

Communities or zones of Marine and Estuarine Rocky Shores have been widely studied (Lewis 1964; Ricketts and Calvin 1968; Stephenson and Stephenson 1972). Each zone supports a rich assemblage of invertebrates and algae or lichens or both. Dominance Types of the Rocky Shores often can be characterized by one or two dominant genera from these zones.

The uppermost zone (here termed the littorine-lichen zone) is dominated by periwinkles (*Littorina* and *Nerita*) and lichens. This zone frequently takes on a dark, or even black appearance, although abundant lichens may lend a colorful tone. These organisms are rarely submerged, but are kept moist by sea spray. Frequently this habitat is invaded from the landward side by semimarine genera such as the slater *Ligia*.

The next lower zone (the balanoid zone) is commonly dominated by mollusks, green algae, and barnacles of the balanoid group. The zone appears white. Dominance Types such as the barnacles *Balanus*, *Chthamalus*, and *Tetraclita* may form an almost pure sheet, or these animals may be interspersed with mollusks, tube worms, and algae such as *Pelvetia*, *Enteromorpha*, and *Ulva*.

The transition between the littorine-lichen and balanoid zones is frequently marked by the replacement of the periwinkles with limpets such as *Acmaea* and *Siphonaria*. The limpet band approximates the upper limit of the regularly flooded intertidal zone.

In the middle and lower intertidal areas, which are flooded and exposed by tides at least once daily, lie a number of other communities which can be characterized by dominant genera. *Mytilus* and gooseneck barnacles (*Pollicipes*) form communities exposed to strong wave action. Aquatic Beds dominated by *Fucus* and *Laminaria* lie slightly lower, just above those dominated by coralline algae (*Lithothamnion*). The *Laminaria* Dominance Type approximates the lower end of the Intertidal Subsystem; it is generally exposed at least once daily. The *Lithothamnion* Dominance Type forms the transition to the Subtidal Subsystem and is exposed only irregularly.

In the Palustrine, Riverine, and Lacustrine Systems, various species of lichens such as *Verrucaria* spp. and *Dermatocarpon fluviatile*, as well as blue-green algae, frequently form characteristic zones on Rocky Shores. The distribution of these species depends on the duration of flooding or wetting by spray and is similar to the zonation of species in the Marine and Estuarine Systems (Hutchinson 1975). Though less abundant than lichens, aquatic liverworts such as *Marsupella emarginata* var. *aquatica* or mosses such as *Fissidens julianus* are found on the Rocky Shores of lakes and rivers. If aquatic liverworts or mosses cover 30 percent or more of the substrate, they should be placed in the Class Aquatic Bed. Other examples of Rocky Shore Dominance Types are the caddisfly *Hydropsyche* and the fingernail clam *Pisidium*.

3.2.7 Unconsolidated Shore

Definition. The Class Unconsolidated Shore includes all wetland habitats having three characteristics: (1) unconsolidated substrates with less than 75 percent areal cover of stones, boulders, or bedrock; (2) less than 30 percent areal cover of vegetation other than pioneer plants; and (3) any of the following Water Regimes: Irregularly Exposed, Regularly Flooded, Irregularly Flooded, Seasonally Flooded, Seasonally Flooded-Saturated, or Temporarily Flooded, Intermittently Flooded, Regularly Flooded-Tidal Fresh, Seasonally Flooded-Tidal Fresh, or Temporarily Flooded-Tidal Fresh. Intermittent or intertidal channels of the Riverine System and intertidal channels of the Estuarine System are classified as Streambed.

Description. Unconsolidated Shores are characterized by substrates lacking vegetation except for pioneer plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves and currents produce a number of landforms such as beaches, bars, and flats, all of which are included in this Class. Unconsolidated Shores are commonly found adjacent to Unconsolidated Bottoms in all Systems; in the Palustrine and Lacustrine Systems, the Class may occupy the entire basin. As in Unconsolidated Bottoms, the particle size of the substrate and the water regime are the important factors determining the types of plant and animal communities present. Different substrates usually support characteristic invertebrate fauna. Faunal distribution is controlled by waves, currents, interstitial moisture, salinity, and grain size (Hedgpeth 1957; Ranwell 1972; Riedl and McMahan 1974).

Subclasses and Dominance Types.

Cobble-Gravel. The unconsolidated particles smaller than stones are predominantly cobbles and gravel. Shell fragments, sand, and silt often fill the spaces between the larger particles. Stones and boulders may be found scattered on some Cobble-Gravel Shores. In areas of strong wave and current action these shores take the form of beaches or bars, but occasionally they form extensive flats. Examples of Dominance Types in the Marine and Estuarine Systems are: the acorn barnacle *Balanus*, the limpet *Patella*, the periwinkle *Littorina*, the rock shell *Thais*, the mussels *Mytilus* and *Modiolus*, and the Venus clam *Saxidomus*. In the Lacustrine, Palustrine, and Riverine Systems examples of Dominance Types are the freshwater mollusk *Elliptio*, the snails *Lymnaea* and *Physa*, the toad bug *Gelastocoris*, the leech *Erpodella*, and the springtail *Agrenia*.

Sand. The unconsolidated particles smaller than stones are predominantly sand, although finer or coarser sediments may be intermixed. Sand may be either calcareous or terrigenous in origin. Sand shores are a prominent feature of the Marine, Estuarine, Riverine, and Lacustrine Systems where the substrate material is exposed to the sorting and washing action of waves. Examples of Dominance Types in the Marine and Estuarine Systems are the wedge shell *Donax*, the soft-shell clam *Mya*, the quahog *Mercenaria*, the olive shell *Oliva*, the blood worm *Euzonus*, the beach hopper *Orchestia*, the pismo clam *Tivela stultorum*, the mole crab *Emerita*, and the lugworm *Arenicola*. Examples of Dominance Types in the Riverine, Lacustrine, and Palustrine Systems are the copepods *Parastenocaris* and *Phyllognathopus*, the oligochaete worm *Pristina*, the freshwater mollusks *Anodonta* and *Elliptio*, and the fingernail clams *Pisidium* and *Sphaerium*.

Mud. The unconsolidated particles smaller than stones are predominantly silt and clay, although coarser sediments or organic material may be intermixed. Anaerobic conditions often exist below the surface. Mud Shores have a higher organic content than Cobble-Gravel or Sand Shores. They are typically found in areas of minor wave action. They tend to have little slope and are frequently called flats. Mud Shores support diverse populations of tube-dwelling and burrowing invertebrates that include worms, clams, and crustaceans (Gray 1974). They are commonly colonized by algae and diatoms which may form a crust or mat.

Irregularly flooded Mud Shores in the Estuarine System have been called salt flats, pans, or pannes. They are typically high in salinity and are usually surrounded by, or lie on the landward side of, Emergent Wetland (Martin et al. 1953, Type 15). In many arid areas, Palustrine and Lacustrine Mud Shores are encrusted or saturated with salt. Martin et al. (1953) called these habitats inland saline flats (Type 9); they are also called alkali flats, salt flats, and salt pans. Mud Shores may also result from removal of vegetation by man, animals, or fire, or from the discharge of thermal waters or pollutants.

Examples of Dominance Types in the Marine and Estuarine Systems include the fiddler crab *Uca*, the ghost shrimp *Callianassa*, the mud snails *Nassarius* and *Macoma*, the clam worm *Nereis*, the sea anemone *Cerianthus*, and the sea cucumber *Thyone*. In the Lacustrine, Palustrine, and Riverine Systems, examples of Dominance Types are the fingernail clam *Pisidium*, the snails *Aplexa* and *Lymaea*, the crayfish *Procambarus*, the harpacticoid copepods *Canthocamptus* and *Bryocamptus*, the fingernail clam *Sphaerium*, the freshwater mollusk *Elliptio*, the shore bug *Saldula*, the isopod *Asellus*, the crayfish *Cambarus*, and the mayfly *Tortopus*.

Organic. The unconsolidated material smaller than stones is predominantly organic; there is no minimum depth requirement. The organic material is dead plant tissue in varying stages of decomposition. In the Marine and Estuarine Systems, Organic Shores are often dominated by microinvertebrates such as foraminifera, and by *Nassarius*, *Littorina*, *Uca*, *Modiolus*, *Mya*, *Nereis*, and the false angel wing *Petricola pholadiformis*. In the Lacustrine, Palustrine, and Riverine Systems, examples of Dominance Types are *Canthocamptus*, *Bryocamptus*, *Chironomus*, and the backswimmer *Notonecta*.

Vegetated. Some nontidal Shores are exposed for a sufficient period to be colonized by pioneer plants that, unlike Emergent Wetland plants or Scrub-Shrub Wetland plants, are usually killed by rising water levels. Many of the pioneer species are weedy mesophytes or xerophytes. At least 30 percent cover of pioneer plants is required. Examples of Dominance Types are rough cocklebur (*Xanthium strumarium*) and large barnyard grass (*Echinochloa crusgalli*).

Dominance Types for Unconsolidated Shores in the Marine and Estuarine Systems were taken primarily from Smith (1964), Morris (1966), Abbott (1968), Ricketts and Calvin (1968), and Gosner (1971). Dominance Types for Unconsolidated Shores in the Lacustrine, Riverine, and Palustrine Systems were taken primarily from Stehr and Branson (1938), Kenk (1949), Ward and Whipple (1959), Cummins et al. (1964), Johnson (1970), Ingram (1971), Clarke (1973), and Hart and Fuller (1974).

3.2.8 Moss-Lichen Wetland

Definition. The Moss-Lichen Wetland Class includes areas where mosses or lichens cover at least 30 percent of substrates other than rock and where emergents, shrubs, or trees alone or in combination cover less than 30 percent. Water Regimes include Seasonally Saturated and Continuously Saturated.

Description. Mosses and lichens are important components of the flora in many wetlands, especially in the North, but these plants usually form a ground cover under a dominant layer of trees, shrubs, or emergents. In some instances higher plants are uncommon and mosses or lichens dominate the flora. Such Moss-Lichen Wetlands are not common, even in the northern U.S. where they occur most frequently.

Subclasses and Dominance Types.

Moss. In this Subclass, the areal coverage of mosses exceeds that of lichens. Moss dominated wetlands are most abundant in the far northern boreal forests and Arctic tundra, where they are dominated by peat mosses such as *Sphagnum fuscum* and *S. warnstorfii*. These wetlands are typically called bogs (Golet and Larson 1974; Jeglum et al. 1974; Zoltai et al. 1975), whether *Sphagnum* or higher plants dominate. In Alaska, *Drepanocladus revolvans*, *D. lycodiodes*, and the liverwort *Chiloscyphus fragilis* may dominate shallow pools with semipermanent water. Other mosses, including *Campylium stellatum*, *Aulacomnium palustre*, *A. turgidum* and *Oncophorus wahlenbergii*, are typical of wet, saturated soils in these regions (Britton 1957, Drury 1962).

Lichen. In this Subclass, the areal coverage of lichens exceeds that of mosses. Lichen Wetlands also are a Northern Subclass. Reindeer moss (*Cladina* and *Cladonia*), the principal Dominance Type, occurs primarily in boreal and Arctic regions. Lichen cover is generally elevated above moss, sedge-moss, or dwarf shrub-sedge-moss layers. Pollett and Bridgewater (1973) described areas with mosses and lichens as bogs or fens, the distinction being based on the availability of nutrients and the particular plant species present. The presence of Lichen Wetlands has been noted in the Hudson Bay Lowlands (Sjörs 1959) and in Ontario (Jeglum et al. 1974).

3.2.9 Emergent Wetland

Definition. In this wetland Class, emergent plants—i.e., erect, rooted, herbaceous hydrophytes, excluding mosses and lichens—are the tallest life form with at least 30% areal coverage. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. All Water Regimes are included except Subtidal and Irregularly Exposed.

Description. In areas with relatively stable climatic conditions, Emergent Wetlands maintain the same appearance year after year. In other areas, such as the prairies of the central U.S., violent climatic fluctuations cause them to revert to an open water phase in some years (Stewart and Kantrud 1972). Emergent Wetlands are found throughout the U.S. and occur in all Systems except the Marine. Emergent Wetlands are known by many names, including marsh, wet meadow, fen, prairie pothole, and slough. Areas that are dominated by pioneer plants, which become established during periods of low water, are not Emergent Wetlands and should be classified as Vegetated Unconsolidated Shores or Vegetated Streambeds.

Subclasses and Dominance Types.

Persistent. In this Subclass, the areal coverage of persistent emergents exceeds that of nonpersistent emergents. Persistent emergents are emergent hydrophytes whose stems and leaves are evident all year above the surface of the water, or above the soil surface if water is absent. Persistent Emergent Wetlands occur only in the Estuarine and Palustrine Systems.

Persistent Emergent Wetlands dominated by saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*S. patens*), big cordgrass (*S. cynosuroides*), Roemer's rush (*Juncus roemerianus*), narrow-leaved cattail (*Typha angustifolia*), and mash-millet (*Zizaniopsis miliacea*) are major components of the Estuarine Systems of the Atlantic and Gulf Coasts of the U.S. On the Pacific Coast, woody saltwort (*Salicornia virginica*), broom seepweed (*Suaeda californica*), seaside arrow-grass (*Triglochin maritimum*), and California cordgrass (*Spartina foliosa*) are common dominants.

Palustrine Persistent Emergent Wetlands contain a vast array of grasslike plants such as cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), saw grass (*Cladium jamaicense*), sedges (*Carex* spp.); and true grasses such as manna grasses (*Glyceria* spp.), slough grass (*Beckmannia syzigachne*), and common river grass (*Scolochloa festucacea*). There is also a variety of broad-leaved persistent emergents such as purple loosestrife (*Lythrum salicaria*), Mexican dock (*Rumex mexicanus*), swamp loosestrife (*Decodon verticillatus*), and some species of smartweeds (*Polygonum*).

Nonpersistent. In this Subclass, the areal coverage of nonpersistent emergents exceeds that of persistent emergents. Nonpersistent emergents are emergent hydrophytes whose stems and leaves are evident above the water surface, or above the soil surface if surface water is absent, only during the growing season or shortly thereafter. During the dormant season, there is no obvious sign of emergent vegetation. Nonpersistent Emergent Wetlands occur in all Systems except the Marine. Nonpersistent emergents also include species such as green arrow-arum (*Peltandra virginica*), pickerelweed (*Pontederia cordata*), and arrowheads (*Sagittaria* spp.). Movement of ice in Estuarine, Riverine, or Lacustrine Systems often removes all traces of emergent vegetation during the winter. Where this occurs, the area should be classified as Nonpersistent Emergent Wetland.

3.2.10 Scrub-Shrub Wetland

Definition. In Scrub-Shrub Wetlands, woody plants less than 6 m (20 ft) tall are the dominant life form—i.e., the tallest life form with at least 30 percent areal coverage. The “shrub” life form actually includes true shrubs, young specimens of tree species that have not yet reached 6 m in height, and woody plants (including tree species) that are stunted because of adverse environmental conditions. All Water Regimes except Subtidal are included.

Description. Scrub-Shrub Wetlands may represent a successional stage leading to Forested Wetland, or they may be relatively stable communities. They occur only in the Estuarine and Palustrine Systems, but are one of the most widespread Classes in the U.S. (Shaw and Fredine 1956). Scrub-Shrub Wetlands are known by many names, such as shrub swamp (Shaw and Fredine 1956), shrub carr (Curtis 1959), bog (Heinselman 1970), fen (Jeglum 1974), and pocosin (Kologiski 1977). For practical reasons we have also included stands of young trees less than 6 m tall.

Subclasses and Dominance Types.

Broad-leaved Deciduous. In this Subclass, broad-leaved deciduous species have the greatest areal coverage within the shrub layer. In the Estuarine System, Dominance Types include species such as sea-myrtle (*Baccharis halimifolia*) and high-tide bush (*Iva frutescens*). In the Palustrine System, typical Dominance Types are alders (*Alnus* spp.), willows (*Salix* spp.), buttonbush (*Cephalanthus occidentalis*), red osier dogwood (*Cornus stolonifera*), honeycup (*Zenobia pulverulenta*), Douglas' meadowsweet (*Spiraea douglasii*), bog birch (*Betula pumila*), and young red maple (*Acer rubrum*).

Needle-leaved Deciduous. In this Subclass, needle-leaved deciduous species have the greatest areal coverage within the shrub layer. Dominance Types include young or stunted tamarack and southern bald-cypress (*Taxodium distichum*).

Broad-leaved Evergreen. In this Subclass, broad-leaved evergreen species have the greatest areal coverage within the shrub layer. In the Estuarine System, vast wetland acreages are dominated by mangroves (*Rhizophora mangle*, *Languncularia racemosa*, *Conocarpus erectus*, and *Avicennia germinans*). In the Palustrine System, the broad-leaved evergreen species are typically found on organic soils. Northern representatives are labrador tea (*Ledum groenlandicum*), bog rosemary (*Andromeda polifolia L.*), bog laurel (*Kalmia polifolia*), and the semi-evergreen, leatherleaf (*Chamaedaphne calyculata*). In the South, shinyleaf (*Lyonia lucida*), coastal dogbobble (*Leucothoe axillaris*), inkberry (*Ilex glabra*), and the semi-evergreen, swamp titi (*Cyrilla racemiflora*), are characteristic broad-leaved evergreen species.

Needle-leaved Evergreen. In this Subclass, needle-leaved evergreen species have the greatest areal coverage within the shrub layer. Examples of Dominance Types include young or stunted black spruce (*Picea mariana*) and pond pine (*Pinus serotina*).

Dead. This Subclass includes stands of dead woody plants less than 6 m tall, regardless of their density, with less than 30 percent cover of living vegetation. If living vegetation equals or exceeds 30 percent in such stands, the Class and Subclass are based on the dominant life form of the living plants. Dead Scrub-Shrub Wetlands are usually produced by a prolonged rise in the water level resulting from impoundment by landslides, humans, or beavers. Such wetlands may also result from fire, salt spray, sea level rise, insect infestation, air pollution or herbicides.

3.2.11 Forested Wetland

Definition. In Forested Wetlands, trees are the dominant life form—i.e., the tallest life form with at least 30 percent areal coverage. Trees are defined as woody plants at least 6 m (20 ft) in height. All Water Regimes are included except Subtidal.

Description. Forested Wetlands are most common in the eastern U.S. and in those sections of the West where moisture is relatively abundant, particularly along rivers and in the mountains. They occur only in the Palustrine and Estuarine Systems and normally possess an overstory of trees, an understory of young trees or shrubs, and an herbaceous layer. Forested Wetlands in the Estuarine System, which include the mangrove forests of Florida, Puerto Rico, and the Virgin Islands, are known by such names as swamps, hammocks, heads, and bottoms. Such common names are often applied, in combination with species names or plant association names, in Palustrine forests as well (e.g., cedar swamp, bottomland hardwoods).

Subclasses and Dominance Types.

Broad-leaved Deciduous. In this Subclass, broad-leaved deciduous species have the greatest areal coverage in the tree layer. Broad-leaved Deciduous Forested Wetlands, which are represented throughout the United States, are most common in the South and East. Common Dominance Types include red maple, American elm (*Ulmus americana*), ashes (*Fraxinus pennsylvanica* and *F. nigra*), black gum (*Nyssa sylvatica*), tupelo gum (*N. aquatica*), swamp white oak (*Quercus bicolor*), overcup oak (*Q. lyrata*), and swamp chestnut oak (*Q. michauxii*). Wetlands in this Subclass generally occur on mineral soils or highly decomposed organic soils.

Needle-leaved Deciduous. In this Subclass, needle-leaved deciduous species have the greatest areal coverage in the tree layer. The southern representative of the Needle-leaved Deciduous Subclass is bald cypress, which is noted for its ability to tolerate long periods of surface inundation. Tamarack is characteristic of the Boreal Forest Region, where it occurs as a dominant on organic soils. Relatively few other species are included in this Subclass.

Broad-Leaved Evergreen. In this Subclass, broad-leaved evergreen species have the greatest areal coverage in the tree layer. In the Southeast, Broad-leaved Evergreen Forested Wetlands reach their greatest development. Red bay (*Persea borbonia*), loblolly bay (*Gordonia lasianthus*), and sweet bay (*Magnolia virginiana*) are prevalent, especially on organic soils. Other Dominance Types include red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), and white mangrove (*Languncularia racemosa*), which are adapted to varying levels of salinity.

Needle-leaved Evergreen. In this Subclass, needle-leaved evergreen species have the greatest areal coverage in the tree layer. Black spruce, growing on nutrient-poor organic soils, represents a major dominant of the Needle-leaved Evergreen Subclass in the North. Eastern arborvitae (*Thuja occidentalis*) dominates northern wetlands on more nutrient-rich sites. Along the Atlantic Coast, Atlantic white cedar (*Chamaecyparis thyoides*) is one of the most common dominants on organic soils. Pond pine is a common needle-leaved evergreen found in the Southeast in association with dense stands of broad-leaved evergreen and deciduous shrubs.

Dead. This Subclass includes stands of dead woody plants 6 m in height or taller, regardless of their density, with less than 30 percent cover of living vegetation. If living vegetation equals or exceeds 30 percent in such stands, the Class and Subclass are based on the dominant life form of the living plants. Dead Forested Wetlands, like Dead Scrub-Shrub Wetlands, are most common in, or around the edges of, man-made impoundments and beaver ponds. The same factors that produce Dead Scrub-Shrub Wetlands produce Dead Forested Wetlands.

3.3 Modifiers

To fully describe wetlands and deepwater habitats, one must apply certain Modifiers to the classification hierarchy. The Modifiers described were adapted from existing classifications or were developed specifically for this classification system.

3.3.1 Water Regime Modifiers

Description of hydrologic characteristics requires detailed knowledge of the duration and timing of surface inundation, both yearly and long-term, as well as an understanding of groundwater fluctuations. Because such information is seldom available, the Water Regimes that, in part, determine characteristic wetland and deepwater plant and animal communities are described here in only general terms. Water Regimes are grouped under three major headings, Tidal Salt, Nontidal, and Tidal Fresh.

Tidal Salt.

Tidal Salt Water Regime Modifiers are used for wetlands and deepwater habitats in the Marine and Estuarine Systems, where ocean-derived salinity equals or exceeds 0.5 ppt. These Water Regimes are primarily a function of oceanic tides.

Subtidal. Tidal salt water continuously covers the substrate.

Irregularly Exposed. Tides expose the substrate less often than daily.

Regularly Flooded. Tides alternately flood and expose the substrate at least once daily.

Irregularly Flooded. Tides flood the substrate less often than daily.

The periodicity and amplitude of tides vary in different parts of the U.S., mainly because of differences in latitude and geomorphology. On the Atlantic Coast, two nearly equal high tides are the rule (semidiurnal); on the Gulf Coast, there is frequently only one high tide and one low tide each day (diurnal); and on the Pacific Coast there are usually two unequal high tides and two unequal low tides (mixed semidiurnal).

Ttides range in height from about 9.5 m (31 ft) at St. John, New Brunswick (NOAA 1973) to less than 1 m (3.3 ft) along the Louisiana coast (Chabreck 1972). Tides of only 10 cm (4.0 inches) are not uncommon in Louisiana. Therefore, although no hard and fast rules apply, the division between Regularly Flooded and Irregularly Flooded Water Regimes would probably occur approximately at mean high water on the Atlantic Coast, at the lowest level of the higher high tide on the Pacific Coast, and just above mean tide level of the Gulf Coast. The width of the intertidal zone is determined by the tidal range, the slope of the shoreline, and the degree of exposure of the site to wind and waves.

Nontidal.

Nontidal Water Regime Modifiers are used for all nontidal parts of the Palustrine, Lacustrine, and Riverine Systems. Although not influenced by oceanic tides, Nontidal Water Regimes may be affected by wind or seiches in lakes. Nontidal Water Regimes are defined in terms of the growing season which, for the purposes of this classification, begins with green-up and bud-break of native plants in the spring and ends with plant dieback and leaf-drop in the fall due to the onset of cold weather. During the rest of the year, which is defined as the dormant season, even extended periods of flooding may have little influence on the development or survival of plant communities.

Permanently Flooded. Water covers the substrate throughout the year in all years.

Intermittently Exposed. Water covers the substrate throughout the year except in years of extreme drought.

Semipermanently Flooded. Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.

Seasonally Flooded. Surface water is present for extended periods (generally for more than a month) during the growing season, but is absent by the end of the season in most years. When surface water is absent, the depth to substrate saturation may vary considerably among sites and among years.

Seasonally Flooded-Saturated. Surface water is present for extended periods (generally for more than a month) during the growing season, but is absent by the end of the season in most years. When surface water is absent, the substrate typically remains saturated at or near the surface.

Seasonally Saturated. The substrate is saturated at or near the surface for extended periods during the growing season, but unsaturated conditions prevail by the end of the season in most years. Surface water is typically absent, but may occur for a few days after heavy rain and upland runoff.

Continuously Saturated. The substrate is saturated at or near the surface throughout the year in all, or most, years. Widespread surface inundation is rare, but water may be present in shallow depressions that intersect the groundwater table, particularly on a floating peat mat.

Temporarily Flooded. Surface water is present for brief periods (from a few days to a few weeks) during the growing season, but the water table usually lies well below the ground surface for the most of the season.

Intermittently Flooded. The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. Weeks, months, or even years may intervene between periods of inundation. The dominant plant communities under this Water Regime may change as soil moisture conditions change. Some areas exhibiting this Water Regime do not fall within our definition of wetland because they do not have hydric soils or support hydrophytes. This Water Regime is generally limited to the arid West.

Artificially Flooded. The amount and duration of flooding are controlled by means of pumps or siphons in combination with dikes, berms, or dams. The vegetation growing on these areas cannot be considered a reliable indicator of Water Regime. Examples of Artificially Flooded wetlands are some agricultural lands managed under a rice-soybean rotation, and wildlife management areas where forests, crops, or pioneer plants may be flooded or dewatered to attract wetland wildlife. Neither wetlands within or resulting from leakage from man-made impoundments, nor irrigated pasture lands supplied by diversion ditches or artesian wells, are included under this Modifier. The Artificially Flooded Water Regime Modifier should not be used for impoundments or excavated wetlands unless both water inputs and outputs are controlled to achieve a specific depth and duration of flooding.

Tidal Fresh.

The Tidal Subsystem of the Riverine System and tidally influenced parts of the Palustrine and Lacustrine Systems require special Water Regime Modifiers that reflect both tidal and nontidal hydrology. In these habitats, ocean-derived salts measure less than 0.5 ppt. If the substrate in these habitats is flooded and exposed daily by tides, we apply a Regularly Flooded-Tidal Fresh Water Regime Modifier because the tidal effect predominates. If the substrate in these habitats is either permanently covered with fresh water that fluctuates in depth with the tides, or is only irregularly flooded by the tides, we apply the appropriate Nontidal Water Regime Modifier with the suffix "-Tidal Fresh" added, as in Seasonally Flooded-Tidal Fresh. This convention indicates that the habitat is influenced by tides, but that the Water Regime is driven primarily by nontidal inputs and outputs.

Permanently Flooded-Tidal Fresh. Tidal fresh water covers the substrate throughout the year in all years.

Semipermanently Flooded-Tidal Fresh. Tidal fresh surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.

Regularly Flooded-Tidal Fresh. Tides alternately flood the substrate with fresh water and expose it at least once daily.

Seasonally Flooded-Tidal Fresh. Tidal fresh surface water is present for extended periods (generally for more than a month) during the growing season, but is absent by the end of the season in most years. When surface water is absent, the depth to substrate saturation may vary considerably among sites and among years.

Temporarily Flooded-Tidal Fresh. Tidal fresh surface water is present for brief periods (from a few days to a few weeks) during the growing season, but the water table usually lies well below the ground surface for the most of the season.

3.3.2 Water Chemistry Modifiers

The accurate characterization of water chemistry in wetlands and deepwater habitats is difficult, both because of problems in measurement and because values tend to vary with changes in the season, weather, time of day, and other factors. Yet, very subtle changes in water chemistry, which occur over short distances, may have a marked influence on the types of plants or animals that inhabit an area. A description of water chemistry, therefore, must be an essential part of this classification system.

Two kinds of Water Chemistry Modifiers are employed in this classification: Salinity Modifiers and pH (hydrogen-ion) Modifiers. All habitats are classified according to salinity, and freshwater habitats are further classified by pH levels.

3.3.2.1 Salinity Modifiers

Differences in salinity are reflected in the species composition of plants and animals. Many authors have suggested using biological changes as the basis for subdividing the salinity range between sea water and fresh water (Remane and Schlieper 1971). Others have suggested a similar subdivision for salinity in inland wetlands (Moyle 1946; Bayly 1967; Stewart and Kantrud 1971). Since the gradation between fresh and hypersaline or hyperhaline waters is continuous, any boundary is artificial, and few classification systems agree completely. The salinity classification adopted here for both coastal and inland waters is a modified version of the Venice System (1959), which was originally proposed at an international "Symposium on the Classification of Brackish Waters."

Estuarine and Marine waters are a complex solution of salts, dominated by sodium chloride (NaCl). The term *haline* is used to indicate the dominance of ocean salt. The relative proportions of the various major ions are usually similar to those found in sea water, even if the water is diluted below sea water strength. Dilution of sea water with fresh water and concentration of sea water by evaporation result in a wide range of recorded salinities in both surface water and interstitial water within the substrate.

The salinity of inland water is dominated by four major cations, calcium (Ca), magnesium (Mg), sodium (Na), and potassium (K); and three major anions, carbonate ($C0_3$), sulfate (SO_4), and chloride (Cl) (Wetzel 1975). Salinity is governed by the interactions between precipitation, surface runoff, groundwater flow, evaporation, and sometimes evapotranspiration by plants. The ionic ratios of inland waters usually differ appreciably from those in the sea, although there are exceptions (Bayly 1967). The great chemical diversity of these waters, the wide variation in physical conditions such as temperature, and often the relative impermanence of surface water, make it extremely difficult to subdivide the inland salinity range in a meaningful way. Bayly (l967) attempted a subdivision on the basis of animal life; Moyle (1945) and Stewart and Kantrud (1971) have suggested two very different divisions on the basis of plant life.

The term *saline* is used to indicate that any of a number of ions may be dominant or codominant. These salinities are expressed in units of specific conductance as well as percent salt (Ungar 1974) and they are also covered by the salinity ranges in Table 2.

Table 2. Salinity Modifiers

Coastal Modifiers[a]	Inland Modifiers[b]	Salinity (ppt)	Approximate Specific Conductance (µMhos at 25°C)
Hyperhaline	Hypersaline	>40	>60,000
Euhaline	Eusaline	30.0-40	45,000-60,000
Mixohaline	Mixosaline[c]	0.5-30	800-45,000
Polyhaline	Polysaline	18.0-30	30,000-45,000
Mesohaline	Mesosaline	5.0-18	8,000-30,000
Oligohaline	Oligosaline	0.5-5	800-8,000
Fresh	Fresh	<0.5	<800

[a] Coastal Modifiers are used in the Marine and Estuarine Systems.
[b] Inland Modifiers are used in the Riverine, Lacustrine, and Palustrine Systems.

3.3.2.2 pH Modifiers

Acid waters are, almost by definition, poor in calcium and often generally low in other ions, but some very soft waters may have a neutral pH (Hynes 1970). It is difficult to separate the effects of high concentrations of hydrogen ions from low base content, and many studies suggest that acidity may never be the major factor controlling the presence or absence of particular plants and animals. Nevertheless, some researchers have demonstrated a good correlation between pH levels and plant distribution (Sjörs 1950; Jeglum 1971). Jeglum (1971) showed that plants can be used to predict the pH of moist peat.

There seems to be little doubt that, where a peat layer isolates plant roots from the underlying mineral substrate, the scarcity of minerals in the root zone strongly influences the types of plants that occupy the site. For this reason, many authors subdivide freshwater, organic wetlands into mineral-rich and mineral-poor categories (Sjörs 1950; Heinselman 1970; Jeglum 1971; Moore and Bellamy 1974). We have instituted pH Modifiers for freshwater wetlands (Table 3) because pH has been widely used to indicate the difference between mineral-rich and mineral-poor sites, and because it is relatively easy to determine. The ranges presented here are similar to those of Jeglum (1971), except that the upper limit of the circumneutral level (Jeglum's mesotrophic) was raised to bring it into agreement with usage of the term in the U.S. The ranges given apply to the pH of water. They were converted from Jeglum's moist-peat equivalents by adding 0.5 pH units.

Table 3. pH Modifiers

Modifier	pH of Water
Acid	<5.5
Circumneutral	5.5-7.4
Alkaline	>7.4

3.3.3 Soil Modifiers

Soil is one of the most important physical components of wetlands. Through its depth, mineral composition, organic matter content, moisture regime, temperature regime, and chemistry, it exercises a strong influence over the types of plants that live on its surface and the kinds of organisms that dwell within it. In addition, the nature of soil in a wetland, particularly the thickness of organic soil, is of critical importance to engineers planning construction of highways or buildings. For these and other reasons, it is essential that soil be considered in the classification of wetlands.

As noted in Section 2.2, we have placed the boundary between wetlands and deepwater habitats in the Riverine and Lacustrine Systems at a depth of 2.5 m (8.2 ft) below low water because this represents the approximate limit of soil as defined in Soil Taxonomy (Soil Survey Staff 1999) and the approximate maximum depth to which emergent plants normally grow (Welch 1952, Zhadin and Gerd 1963, Sculthorpe 1967). Thus, according to our definitions, inland wetlands may have soil, but inland deepwater habitats do not. All Palustrine waters are less than 2.5 m deep; therefore, potentially all Palustrine habitats have soil. In the Marine and Estuarine Systems, the deep limit of soil lies at a depth of 2.5 m below extreme low water; however, we separate wetlands from deepwater habitats precisely at the extreme low water mark in those Systems. So, according to our definitions, Marine and Estuarine wetlands may have soil, and deepwater habitats also may have soil out to the 2.5-m depth limit.

The most basic distinction in soil classification in the U.S. is between mineral soil and organic soil (Soil Survey Staff 1999). In general*"a soil is classified as an organic soil (Histosols) if more than half of the upper 80 cm (32 inches) of the soil is organic or if organic soil material of any thickness rests on rock or on fragmental material having interstices filled with organic matter*." Soil that does not meet this criterion is considered mineral soil. Organic soil material is soil material that contains at least 12-18 percent organic carbon by weight, the required amount depending on the clay content in the mineral fraction (Soil Survey Staff 1999). See Appendix E for additional details on the differences between mineral and organic soils.

The U.S. soil classification is hierarchical and permits the description of soils at several levels of detail. For example, suborders of the order Histosols are recognized according to the degree of decomposition of the organic matter. In the WCS, we use the Soil Modifiers Organic and Mineral, based on the criteria presented above. If a more detailed soil classification is desired, the latest edition of *Keys to Soil Taxonomy* (Soil Survey Staff 2010) should be used.

3.3.4 Special Modifiers

Many wetland and deepwater habitats are man-made, and natural ones have been modified to some degree by the activities of humans or beaver. With the exception of Beaver, all of the Special Modifiers describe human alterations to wetlands. Since the nature of these modifications often greatly influences the character of such habitats, special modifying terms have been included here to emphasize their importance. The following Modifiers should be used singly. It may be difficult, in some instances, to choose the single Special Modifier that best describes the landscape modification. Because the Diked/Impounded Modifier is crucial for use in coastal watersheds as denoting wetland modifications for sea level rise models, it will be given priority over any other Modifiers (e.g., diked/impounded spoil areas will be classified using the Diked/Impounded Modifier.)

Beaver— These wetlands have been created or modified by beaver (*Castor canadensis*). Dam building by beaver may increase the size of existing wetlands or create small impoundments that are easily identified on aerial imagery. Such flooding frequently creates Dead Forested or Dead Scrub-Shrub Wetland initially, followed in a few years by Aquatic Bed and Emergent Wetland.

Partly Drained/Ditched—A partly drained wetland has been altered hydrologically, but soil moisture is still sufficient to support hydrophytes. Drained areas that can no longer support hydrophytes are not considered wetland. This Modifier is also used to identify wetlands containing, or connected to, ditches. The Partly Drained/Ditched Modifier can be applied even if the ditches are too small to delineate. The Excavated Modifier should be used to identify ditches that are large enough to delineate as separate features; however, the Partly Drained/Ditched Modifier also should be applied to the wetland area affected by the ditching.

Farmed—Farmed wetlands occur where the soil surface has been mechanically or physically altered for production of crops, but where hydrophytes would become reestablished if the farming were discontinued. Farmed wetlands should be classified as Palustrine-Farmed. Cultivated cranberry bogs may be classified Palustrine-Farmed or Palustrine Scrub-Shrub Wetland-Farmed.

Excavated—This Modifier is used to identify wetland basins or channels that were excavated by humans.

Diked/Impounded—These wetlands have been created or modified by a man-made barrier or dam that obstructs the inflow or outflow of water.

Artificial Substrate—This Modifier describes concrete-lined drainageways, as well as Rock Bottom, Unconsolidated Bottom, Rocky Shore and Unconsolidated Shore where the substrate material has been emplaced by humans. Jetties and breakwaters are examples of Artificial Rocky Shores.

Spoil— The Spoil Modifier is used to describe wetlands where deposition of spoil material forms the primary substrate type. By definition, spoil is material that has been excavated and emplaced by humans. Ancillary data may be needed to accurately identify spoil in areas such as reclaimed strip mines that have become revegetated.

4. Use of the Classification System

We have designed the various levels of this classification for specific purposes, and the relative importance of each will vary among users. The Systems and Subsystems are most important in applications involving large regions or the entire country. They serve to organize the Classes into meaningful assemblages of information for data storage and retrieval.

The Classes and Subclasses are the most important part of the classification for many users and are basic to habitat mapping. Most Classes should be easily recognizable by users in a wide variety of disciplines. However, the Class designations apply to average conditions over a period of years and, since many habitats are dynamic and subject to rapid changes in appearance, the proper classification will frequently require data that span a period of years and several seasons in each of those years.

The Dominance Type is most important to users interested in detailed regional studies. It may be necessary to identify Dominance Types in order to determine which modifying terms are appropriate, because plants and animals present in an area tend to reflect environmental conditions over a period of time. Water Regime can be determined from long-term hydrologic studies where these are available. The more common procedure is to estimate this characteristic from the Dominance Types. Several studies have related water regimes to the presence and distribution of plants or animals (e.g., Stephenson and Stephenson 1972; Stewart and Kantrud 1972; Chapman 1974).

Similarly, we do not intend that salinity measurements be made for all wetlands or deepwater habitats except where these data are required; often plant species or associations can be used to indicate broad salinity ranges. Lists of halophytes have been prepared for both coastal and inland areas (e.g., Duncan 1974; MacDonald and Barbour 1974; Ungar 1974), and a number of floristic and ecological studies have described plants that are indicators of salinity (e.g., Penfound and Hathaway 1938; Moyle 1945; Kurz and Wagner 1957; Dillon 1966; Anderson et al. 1968; Chabreck 1972; Stewart and Kantrud 1972; Ungar 1974; Odum et al. 1984).

In areas where the Dominance Types to be expected under different Water Regimes and types of Water Chemistry Modifiers have not been identified, detailed regional studies will be required before the classification can be applied in detail. In areas where detailed soil maps are available, it is also possible to infer Water Regime and Water Chemistry from soil map units.

Some of the Modifiers are an integral part of this classification and their use is essential; others are used only for detailed applications or for special cases. The minimum standard for wetland classification is: System, Subsystem (with the exception of Palustrine), Class, Subclass (only required for Forested, Scrub-Shrub, and Emergent Wetland Classes), Water Regime Modifier, and Special Modifier (only required where applicable). The minimum standard for deepwater habitat classification is: System, Subsystem, Class, and Water Regime Modifier.

Water Chemistry Modifiers and Soil Modifiers generally are not used when classification data are obtained using remote sensing. These Modifiers should be applied only when detailed, supporting data have been gathered in the field or from reliable sources such as soil surveys.

The user is urged not to rely on single observations of Water Regime or Water Chemistry. Such measurements give misleading results in all but the most stable habitats. If a more detailed Soil Modifier, such as soil order or suborder (Soil Survey Staff, 2010) can be obtained, it should be used in place of the Modifiers, Mineral and Organic.

5. Regionalization for the Classification System

In 1977 the USFWS adopted Bailey's (1976) ecoregions to give the inland wetlands and deepwater habitats of the United States an ecological address (see Cowardin et al. 1979). For the WCS, the 1995 version of Bailey's ecoregions is to be used wherever there is a need for regionalization in the U.S. interior
(see http://www.fs.fed.us/rm/ecoregions/products/map-ecoregions-united-states/.)

See further information in Appendix F.

6. Application of the FGDC Wetlands Classification Standard

Before attempting to apply the WCS, the user should be aware of the following:

(1) Some information about the area to be classified must be available before the WCS can be applied. This information may be in the form of historical data, aerial photographs or digital images, brief on-site inspection, or detailed and intensive studies.

(2) The classification is designed for use at varying levels of detail. There are few areas for which sufficient information is currently available to allow the most detailed level of classification. If the level of detail provided by the data is not sufficient to meet the classification needs of the user, additional data gathering should be undertaken. In order for projects to conform to the Mapping Standard (FGDC-STD-015-2009), additional data gathering will be required whenever the detail is insufficient to meet the classification requirements of the Standard.

(3) When used in mapping projects, this classification is scale-specific, both for the minimum size of units mapped and for the degree of detail attainable.

(4) This classification provides examples of common Dominance Types for various wetland and deepwater habitats. Users should feel free to add to this list as other dominant species are encountered during regional and local applications of the classification system throughout the United States.

(5) One of the main purposes of the FGDC Wetlands Classification Standard is to ensure uniformity in wetland classification throughout the U.S. It is important that the user pay particular attention to the definitions in this classification. Any deviation from, or modification of, these definitions in the application of this classification system will lead to a lack of uniformity and defeat the purpose of the Standard.

(6) One of the principal uses of the WCS is for inventory and mapping. In order to maintain national consistency, the mapping conventions developed and refined by the USFWS over the first 30 years of NWI mapping were used as the basis for the FGDC Wetlands Mapping Standard (FGDC-STD-015-2009). The Mapping Standard was endorsed by the FGDC in July 2009. It specifies the minimum data quality components for wetlands inventory mapping needed to support inclusion of the data into the National Spatial Data Infrastructure (NSDI), which is mandatory when these activities are fully or partially funded or conducted by the Federal Government. The Mapping Standard balances the burden on the end-user community with the need for consistency and documented quality of digital mapping products. Additionally, the FGDC Wetlands Mapping Standard is created to coordinate wetlands mapping with the National Hydrography Dataset, a national geospatial framework recognized by the FGDC. Although the FGDC Wetlands Mapping Standard is structured to be extensible over time, it is deliberately developed with a forward-looking perspective to accommodate technology and map-scale enhancements to assure its long-term usability, and minimize the need for revisions and updates.

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APPENDIX A (Informative): Glossary of Technical Terms, Acronyms, and Abbreviations

Technical Terms

Definitions provided here come from a variety of sources, including some of the references in Section 7 of this document. Where definitions have been taken verbatim from a source, that source has been cited. In other cases, definitions have been modified or drafted specifically for this classification.

Term	Definition
Acid	Term applied to water with a pH less than 5.5.
Alkaline	Term applied to water with a pH greater than 7.4.
Bar	Elongated landform generated by waves and currents, usually running parallel to the shore, composed predominantly of unconsolidated sand, gravel, stones, cobbles, or rubble and with water on two sides.
Bay	Wide, curving open indentation, recess, or arm of a sea or lake into the land or between two capes or headlands; larger than a cove.
Beach	Sloping landform of unconsolidated material on the shore of larger water bodies, generated by washing waves, tides or currents and extending from the water to a distinct break in landform, substrate type (e.g., a foredune, cliff, or bank), or to the line of continuous vegetation, usually the effective limit of the highest storm waves.
Bedrock	Solid rock layer exposed at the land surface (outcrop) or underlying unconsolidated surface materials such as soil, alluvium, gravel or rock fragments.
Boulder	Rock fragment larger than 60.4 cm (24 inches) in diameter.
Brackish	Marine and Estuarine waters with Mixohaline salinity.
Broad-leaved deciduous	Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that are shed during the cold or dry season; e.g., black ash (*Fraxinus nigra*).
Broad-leaved evergreen	Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that generally remain green and are usually persistent for a year or more; e.g., red mangrove (*Rhizophora mangle*).
Calcareous	Formed of calcium carbonate or magnesium carbonate by biological deposition or inorganic precipitation in sufficient quantities to effervesce carbon dioxide visibly when treated with cold 0.1 normal hydrochloric acid. Calcareous sands are usually formed of a mixture of fragments of mollusk shell, echinoderm spines and skeletal material, coral, foraminifera, and algal platelets (e.g., *Halimeda*).
Channel	"An open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water" (Langbein and Iseri 1960:5).
Channel bank	The sloping land bordering a channel. The bank has steeper slope than the bottom of the channel and is usually steeper than the land surrounding the channel.
Circumneutral	Term applied to water with a pH of 5.5 to 7.4.

Term	**Definition**
Clay	Mineral particles smaller than 0.002 mm composed of naturally occurring aluminum silicate.
Cliff	High, very steep or overhanging geologic face usually produced by erosion.
Codominant	Two or more species providing about equal areal cover which, in combination, control the environment.
Cobble	Rock fragment 7.6 cm (3 inches) to 25.4 cm (10 inches) in diameter.
Continental Shelf	Part of the continental margin that is between the shoreline and the continental slope.
Dam	Obstruction across a hydrologic flow impounding water to produce a lake, pond, wetland, or other widened aquatic feature.
Deciduous stand	Plant community where deciduous trees or shrubs represent more than 50 percent of the total areal coverage of trees or shrubs.
Dike	Artificial wall, embankment, ridge, or mound, usually of earth or rock fill, built around a relatively flat, low-lying area to protect it from flooding; a levee. A dike may also be constructed on the shore or border of a lake or estuary to prevent inflow of water to bordering lands.
Dominant	Species that are most numerous, or form the bulk of the biomass, and therefore have the greatest effect or influence on the ecological community, generally controlling the presence, abundance, or type of other species.
Dominant life form	That life form of plants (e.g., tree, shrub, moss) that constitutes the uppermost layer of vegetation at a site and possesses at least 30 percent areal cover. The dominant life form determines the Class of vegetated wetlands in this classification.
Dormant season	That part of the year that falls outside the growing season.
Embayment	Deep indentation or recess of a shoreline that forms a bay, which may be entirely or partially cut-off from the main water body by intervening features such as roads, railroad beds, culverts, or dams.
Emergent hydrophytes	Rooted herbaceous angiosperms, ferns, and fern allies (e.g., *Equisetum* spp.) that grow in wet soil, stand erect during most or all of the growing season, and may be periodically to permanently flooded at the base, but do not tolerate prolonged inundation of the entire plant. Examples include bulrushes (*Scirpus* spp.), grasses, and sedges.
Emergent mosses	Mosses occurring in wetlands, but generally not covered by water.
Euhaline	Characterizes water with a concentration of ocean-derived salts measuring 30 to 40 parts per thousand (ppt).
Eutrophic lake	Lake that has a high concentration of nutrients such as nitrogen and phosphorus which stimulate the growth of plants or algae such that the oxygen content is depleted and carbon sequestered.
Evergreen stand	Plant community where evergreen trees or shrubs represent more than 50 percent of the total areal coverage of trees and shrubs. The canopy is never without foliage; however, individual trees or shrubs may shed their leaves (Mueller-Dombois and Ellenberg 1974).
Extreme high water of spring tides	Highest tide occurring during a lunar month, usually near the new or full moon. This is equivalent to extreme higher high water of mixed semidiurnal tides.

Term	Definition
Extreme low water of spring tides	Lowest tide occurring during a lunar month, usually near the new or full moon. This is equivalent to extreme lower low water of mixed semidiurnal tides.
Flat	Level landform composed of unconsolidated sediments—usually mud or sand. Flats may be irregularly shaped or elongate and continuous with the shore, whereas bars are generally elongate, parallel to the shore, and separated from the shore by water.
Floating plant	Non-anchored plant that floats freely in the water or on the surface; e.g., water hyacinth (*Eichhornia crassipes*) or common duckweed (*Lemna minor*).
Floating-leaved plant	Rooted, herbaceous hydrophyte with some leaves floating on the water surface; e.g., white water lily (*Nymphaea odorata*), floating-leaved pondweed (*Potamogeton natans*). Plants such as yellow water lily (*Nuphar luteum*) which sometimes have leaves raised above the surface are considered floating-leaved plants or emergents, depending on their growth habit at a particular site.
Floodplain	"flat expanse of land bordering an old river . . ." (Reid and Wood 1976:72, 84).
Fresh water	Water with a dissolved salt concentration measuring less than 0.5 ppt.
Gravel	Mixture composed primarily of rock fragments 2 mm (0.08 inch) to 7.6 cm (3 inches) in diameter. Usually contains much sand.
Growing season	That part of the year that begins with green-up and bud-break of native plants in the spring and ends with plant dieback and leaf-drop in the fall due to the onset of cold weather.
Haline	Indicates dominance of ocean salt (see also Saline).
Herbaceous	With the characteristics of an herb; a plant with no persistent woody stem above ground.
Histosols	The order of organic soils, as defined by USDA Natural Resources Conservation Service in *Soil Taxonomy* (Soil Survey Staff 1999); soils consisting primarily of organic soil material such as peat or muck (see also Organic soil and Appendix E).
Hydric soil	Soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part. The concept of hydric soils includes soils developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation. (From http://soils.usda.gov/use/hydric/intro.html)
Hydrophytes, hydrophytic	Any plant growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.
Hyperhaline	Water with a concentration of ocean-derived salts measuring greater than 40 ppt.
Hypersaline	Water with a concentration of land-derived salts measuring greater than 40 ppt.
Kelp	Any of numerous large seaweeds found in colder seas and belonging to the order Laminariales, brown algae.
Lagoon	A mostly-enclosed, shallow, saline water body with little freshwater input and damped tidal fluxes.

Term	Definition
Levee	An embankment of sediment, bordering one or both sides of natural or artificial channels.
Macrophytic algae	Algal plants large enough either as individuals or communities to be readily visible without the aid of optical magnification.
Mangrove	Tidally-influenced, tropical or subtropical shrub or forest dominated by true mangroves and associates.
Mean high water	Average height of the high water over 19 years.
Mean higher high tide	Average height of the higher of two unequal daily high tides over 19 years.
Mean low water	Average height of the low water over 19 years.
Mean lower low water	Average height of the lower of two unequal daily low tides over 19 years.
Mean tide level	A plane midway between mean high water and mean low water.
Mesohaline	Water with a concentration of ocean-derived salts measuring of 5 to 18 ppt.
Mesophye, mesophytic	Any plant growing where moisture and aeration conditions lie between extremes; plants typically found in habitats with average moisture conditions, not unusually dry or wet.
Mesosaline	Water with a concentration of land-derived salts measuring 5 to 18 ppt.
Mineral soil	Soil composed of predominantly mineral, rather than organic, material (see Appendix E).
Mixohaline	Water with a concentration of ocean-derived salts measuring 0.5 to 30 ppt. The term is roughly equivalent to the term brackish.
Mixosaline	Waters with a concentration of land-derived salts measuring 0.5 to 30 ppt.
Muck	Soil consisting primarily of highly decomposed organic matter (sapric soil material).
Mud	Wet soft earth composed predominantly of clay- and silt-sized mineral particles less than 0.074 mm in diameter (Black 1968; Liu 1970).
Needle-leaved deciduous	Woody gymnosperms (trees or shrubs) with needle-shaped or scale-like leaves that are shed during the cold or dry season; e.g., bald cypress (*Taxodium distichum*).
Needle-leaved evergreen	Woody gymnosperms with green, needle-shaped, or scale-like leaves that are retained by plants throughout the year; e.g., black spruce (*Picea mariana*).
Nonpersistent emergents	Emergent hydrophytes whose stems and leaves are evident above the surface of the water, or above the soil surface if surface water is absent, only during the growing season or shortly thereafter. Typically, plant leaves and stems break down soon after the growing season or drop beneath the water surface (e.g., arrow arum, *Peltandra virginica*; burreed, *Sparganium* spp.; bayonet rush, *Juncus militaris*). Many nonpersistent emergents have fleshy or spongy tissues.
Obligate hydrophyte	Plant that under natural conditions occurs almost always (estimated probability 99 percent) in wetlands, e.g., cattail (*Typha latifolia*), as opposed to species that grow in both wetlands and upland, e.g., red maple (*Acer rubrum*).
Oligohaline	Water with a concentration of ocean-derived salts measuring 0.5 to 5.0 ppt.
Oligosaline	Water with a concentration of land-derived salts measuring 0.5 to 5.0 ppt.

Term	Definition
Organic matter	Organic fraction of the soil exclusive of undecayed plant and animal residues.
Organic soil	Soil composed of predominantly organic rather than mineral material (see Appendix E).
Peat	Soil consisting primarily of poorly to moderately decomposed organic matter (fibric to hemic soil material)
Persistent emergents	Emergent hydrophytes whose stems and leaves are evident throughout the year above the surface of the water, or above the soil surface if surface water is absent. In some species, such as cattails (*Typha* spp.), stems may remain erect all year; in others, stems and leaves may lie prostrate on the soil surface after the peak of the growing season due to tidal action, wind, heavy rain, or snow cover. Plants such as saltmarsh cordgrass (*Spartina alterniflora*), whose stems may be severed during Northern winters by ice, in combination with tidal action, along the edges of tidal creeks or other open water bodies, are considered persistent.
Photic zone	Upper water layer down to the depth of effective light penetration where photosynthesis balances respiration. This level (the compensation level) usually occurs at the depth of 1 percent light penetration and forms the lower boundary of the zone of net metabolic production.
Pioneer plants	Herbaceous annual and seedling perennial plants that colonize bare areas as a first stage in secondary succession.
Polyhaline	Water with a concentration of ocean-derived salts measuring18 to 30 ppt.
Polysaline	Water with a concentration of land-derived salts measuring 18 to 30 ppt.
Reef	Ridge or mound-like structure formed by the colonization and growth of sedentary invertebrates such as corals, mollusks, or tubeworms.
Saline	Water containing various dissolved salts. We restrict the term to inland waters where the ratios of the salts often vary; the term haline is applied to coastal waters where the salts are roughly in the same proportion as found in undiluted sea water.
Salinity	Total amount of solid material in grams contained in 1 kg of water when all the carbonate has been converted to oxide, the bromine and iodine replaced by chlorine, and all the organic matter completely oxidized.
Salt water	Water with a dissolved salt concentration measuring at least 0.5 ppt.
Sand	Unconsolidated mineral sediment composed predominantly of particles with diameters larger than 0.074 mm (Black 1968) and smaller than 2 mm (Liu 1970; Weber 1973).
Shrub	Woody plant that at maturity is less than 6 m (20 ft) tall and generally exhibits several erect, spreading, or prostrate stems and has a bushy appearance; e.g., speckled alder (*Alnus rugosa*) or buttonbush (*Cephalanthus occidentalis*).
Silt	Mineral particles smaller than a very fine sand grain (0.05 mm) and larger than coarse clay (0.002 mm).

Term	Definition
Soil	"Natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface, occupies space, and is characterized by one or both of the following: horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter *or* the ability to support rooted plants in a natural environment" (Soil Survey Staff 1999:9). Areas covered by surface water more than 2.5 m (8.2 ft) deep at low water are not considered to have soil.
Sound	Body of water that is usually broad, elongate, and parallel to the shore between the mainland and one or more islands.
Spring tide	Highest high and lowest low tides during the lunar month.
Stone	Rock fragment larger than 25.4 cm (10 inches) but less than 60.4 cm (24 inches).
Submergent plant	Vascular or nonvascular hygrophyte, either rooted or nonrooted, which lies entirely beneath the water surface, except for flowering parts in some species; e.g., wild celery (*Vallisneria americana*) or the stoneworts (*Chara* spp.).
Substrate	Any material at the land surface upon which, or within which, organisms may live. In this document, substrates consist primarily of unconsolidated mineral material, organic material, or rock that is flooded or saturated long enough each year to support wetland flora and fauna. Individual substrates may or may not qualify as *Soil* (see definition above).
Terrigenous	Derived from or originating on the land (usually referring to sediments) as opposed to material or sediments produced in the ocean (marine) or as a result of biologic activity (biogenous).
Tree	Woody plant which, at maturity, is 6 m (20 ft) or more in height and generally has a single trunk, unbranched for 1 m or more above the ground, and a more or less definite crown; e.g., red maple (*Acer rubrum*), northern white cedar (*Thuja occidentalis*).
Water table	Upper surface of a zone of saturation. No water table exists where that surface is formed by an impermeable body (Langbein and Iseri 1960:21).
Woody plant	Seed plant (gymnosperm or angiosperm) that develops persistent, hard, fibrous tissues, basically xylem; e.g., trees and shrubs.
Xerophyte, xerophytic	Any plant growing in a habitat in which an appreciable portion of the rooting medium dries to the wilting coefficient at frequent intervals; plants typically found in very dry habitats.

Acronyms and Abbreviations

Acronym	Definition
AASHTO	American Association of State Highway and Transportation Officials
BBC	Benthic Biotic Component
CMECS	Coastal and Marine Ecological Classification Standard
EAs	environmental assessments
EHWS	extreme high water of spring tides
EIS	environmental impact statements
ELWS	extreme low water of spring tides
FGDC	Federal Geographic Data Committee
ha	hectare
m	meter
MIT	Massachusetts Institute of Technology
NHD	National Hydrography Dataset
NRCS	Natural Resources Conservation Service; formerly named Soil Conservation Service
NSDI	National Spatial Data Infrastructure
NWI	National Wetlands Inventory
ppt	parts per thousand
U.S.	United States
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
NOAA	National Oceanographic and Atmospheric Administration
WCS	Wetlands Classification Standard, also known as the FGDC Wetlands Classification Standard (FGDC-STD-004), “Classification of Wetlands and Deepwater Habitats of the United States”

APPENDIX B (Informative): Artificial Keys to the Systems and Classes

Artificial Key to the Systems

1. Water Regime influenced by ocean tides, and salinity due to ocean-derived salts 0.5 ppt or greater.
    2. Semi-enclosed by land, but with open, partly obstructed or sporadic access to the ocean. Halinity wide-ranging because of evaporation or mixing of seawater with runoff from land .... ESTUARINE
    2. Little or no obstruction to open ocean present. Halinity usually euhaline; little mixing of water with runoff from land 3
        3. Emergents, trees, or shrubs present... ESTUARINE
        3. Emergents, trees, or shrubs absent..MARINE
1. Water Regime not influenced by ocean tides, or if influenced by ocean tides, salinity less than 0.5 ppt.
    4. Persistent emergents, trees, shrubs, or emergent mosses or lichens cover 30 percent or more of the area .... PALUSTRINE
    4. Persistent emergents, trees, shrubs, or emergent mosses or lichens cover less than 30 percent of substrate but nonpersistent emergents may be widespread during some seasons of year...5
        5. Situated in a channel; water, when present, usually flowing............RIVERINE
        5. Situated in a basin, catchment, or on level or sloping ground; water usually not flowing 6
            6. Area 8 ha (20 acres) or greater...LACUSTRINE
            6. Area less than 8 ha 7
                7. Wave-formed or bedrock shoreline feature present or water depth 2.5 m (8.2 ft) or more...LACUSTRINE
                7. No wave-formed or bedrock shoreline feature present and water less than 2.5-m deep... PALUSTRINE

Artificial Key to the Classes

1. During the growing season of most years, areal cover by vegetation is less than 30 percent.
    2. Substrate a ridge or mound formed by colonization of sedentary invertebrates (corals, mollusks, tube worms) ....REEF
    2. Substrate of rock or various-sized sediments often occupied by invertebrates but not formed by colonization of sedentary invertebrates...3
        3. Water Regime Subtidal, Permanently Flooded, Intermittently Exposed, Semipermanently Flooded, Permanently Flooded-Tidal Fresh, or Semipermanently Flooded-Tidal Fresh..4
            4. Substrate of bedrock, boulders, or stones occurring singly or in combination covers 75 percent or more of the area..........ROCK BOTTOM
            4. Substrate of organic material, mud, sand, gravel, or cobbles with less than 75 percent areal cover of stones, boulders, or bedrock .... UNCONSOLIDATED BOTTOM

3. Water Regime Irregularly Exposed, Regularly Flooded, Irregularly Flooded, Seasonally Flooded, Seasonally Flooded-Saturated, Temporarily Flooded, Intermittently Flooded, Artificially Flooded, Regularly Flooded-Tidal Fresh, Seasonally Flooded-Tidal Fresh, or Temporarily Flooded-Tidal Fresh. 5
    5. Contained in a channel that does not have continuously flowing water (i.e., Intermittent Subsystem of Riverine System or Intertidal Subsystem of Estuarine System) .... STREAMBED
    5. Contained in a channel with continuously flowing water or not contained in a channel 6
        6. Substrate of bedrock, boulders, or stones occurring singly or in combination covers 75 percent or more of the area.... ROCKY SHORE
        6. Substrate of organic material, mud, sand, gravel, or cobbles; less than 75 percent areal cover of stones, boulders, or bedrock ....UNCONSOLIDATED SHORE

1. During the growing season of most years, percentage of area covered by vegetation 30 percent or greater.
    7. Vegetation composed of pioneer annuals or seedling perennials, often not hydrophytes, occurring only at time of substrate exposure 8
        8. Contained in a channel that does not have continuously flowing water ....STREAMBED (VEGETATED)
        8. Contained in a channel with continuously flowing water, or not contained in a channel .... UNCONSOLIDATED SHORE (VEGETATED)
    7. Vegetation composed of algae, mosses, lichens, or vascular plants that are usually hydrophytic perennials...9
        9. Vegetation composed predominantly of nonvascular species 10
            10. Vegetation macrophytic algae, mosses, or lichens growing in water or the splash zone of shores ....AQUATIC BED
            10. Vegetation mosses or lichens usually growing on organic soils and always outside the splash zone of shores ....MOSS-LICHEN WETLAND
        9. Vegetation composed predominantly of vascular species 11
            11. Vegetation herbaceous...12
                12. Vegetation emergents...................................EMERGENT WETLAND
                12. Vegetation submergent, floating-leaved, or floating ....AQUATIC BED
            11. Vegetation trees or shrubs...13
                13. Dominants less than 6 m (20 ft) tall........ SCRUB-SHRUB WETLAND
                13. Dominants 6 m tall or taller ....FORESTED WETLAND

APPENDIX C (Informative): Scientific and Common Names of Plants

Scientific and Common Names of Plants[1]

Scientific Name	Common Name
Acer rubrum L.	Red maple
Alnus spp.	Alders
Andromeda polifolia L.	Bog rosemary
Ascophyllum spp.	Rockweeds
Avicennia germinans (L.) L.	Black mangrove
Azolla spp.	Mosquito ferns
Baccharis halimifolia L.	Groundsel tree
Beckmannia syzigachne (Steud.) Fernald	American slough grass
Betula nana L.	Swamp birch
B. pumila L.	Bog birch
Brasenia schreberi J. F. Gmel.	Water shield
Campylium stellatum (Hedw.) C. Jens	Moss
Carex spp.	Sedges
Caulerpa spp.	Green algae
Cephalanthus occidentalis L.	Common buttonbush
Ceratophyllum muricatum	Prickly hornwort
Chamaecyparis thyoides (L.) B.S.P.	Atlantic white cedar
Chamaedaphne calyculata (L.) Moench	Leatherleaf
Chara spp.	Stoneworts
Chenopodium glaucum L.	Oak-leaf goosefoot
Chiloscyphus fragilis (Roth) Schiffn.	Liverwort
Cladina spp.	Reindeer mosses
Cladium mariscus (L.) Pohl.	Swamp saw-grass
Conocarpus erectus L.	Button mangrove
Cornus alba L.	Red osier dogwood
Cymodocea filiformis (Kuetz) Correll	Manatee grass
Cyrilla racemiflora L.	Swamp titi

[1] Lichvar, R. W., and J. T. Kartesz. 2009. North American Digital Flora: National Wetland Plant List, version 2.4.0 (http://wetland_plants.usace.army.mil). U.S. Army Corps of Engineers, Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire, and BONAP, Chapel Hill, North Carolina.

Scientific Name	Common Name
Decodon verticillatus (L.) Elliott	Swamp loosestrife
Dermatocarpon fluviatile (G. H. Web) Th. Fr.	Lichen
Drepanocladus spp.	Mosses
Echinochloa crusgalli (L.) Beauv.	Large barnyard grass
Eichhornia crassipes (Mart.) Solms	Common water hyacinth
Eleocharis spp.	Spike rushes
Elodea spp.	Water weeds
Fissidens spp.	Mosses
F. julianus (Mont.) Schimper	Moss
Fontinalis spp.	Mosses
Fraxinus nigra Marshall	Black ash
F. pennsylvanica Marshall	Green ash
Fucus spp.	Rockweeds
F. spiralis L.	Rockweed
Glyceria spp.	Manna grasses
Gordonia lasianthus (L.) J. Ellis	Loblolly bay
Halimeda spp.	Green algae
Halodule wrightii Aschers.	Shoal grass
Halophila spp.	Sea grasses
Iva frutescens L.	High-tide bush
Juncus spp.	Rushes
J. militaris Bigel.	Bayonet rush
J. roemerianus Scheele	Roemer's rush
Kalmia polifolia Wangenh.	Bog laurel
Laminaria spp.	Kelps
Languncularia racemosa (L.) C. F. Gaertn.	White mangrove
Larix laricina (DuRoi) K. Koch	American larch
Laurencia spp.	Red algae
Ledum groenlandicum Oeder	Rusty Labrador-tea
Lemna spp.	Duckweeds
L. minor L.	Common duckweed
Leucothoe axillaris (Lam.) D. Don	Coastal doghobble
Lithothamnion spp.	Coralline algae

Scientific Name	Common Name
Lyonia lucida (Lam.) K. Koch	Shinyleaf
Lythrum salicaria L.	Purple loosestrife
Macrocystis spp.	Kelps
Magnolia virginiana L.	Sweet bay
Marsupella spp.	Liverworts
M. emarginata (Ehrenberg) Dumortier	Liverwort
Myriophyllum spp.	Water milfoils
Najas spp.	Naiads
Nitella spp.	Stoneworts
Nuphar lutea (L.) Sibth. & J. E. Smith	Yellow water lily
Nymphaea spp.	Water lilies
N. odorata Soland. in Ait.	White water lily
Nyssa sylvatica Marshall	Black tupelo
Oncophorus wahlenbergii Brid.	Moss
Panicum capillare L.	Common panic grass
Peltandra virginica (L.) Schott	Green arrow-arum
Pelvetia spp.	Rockweeds
Penicillus spp.	Green algae
Persea borbonia (L.) Spreng.	Red bay
Persicaria amphibia (L.) S. F. Gray	Water smartweed
Phyllospadix scouleri Hook.	Scouler's surf-grass
P. torreyi S. Wats.	Torrey's surf-grass
Picea mariana (Mill.) B.S.P.	Black spruce
Pistia stratiotes L.	Water lettuce
Polygonum spp.	Smartweeds
Pontederia cordata L.	Pickerelweed
Potamogeton spp.	Pondweeds
Quercus bicolor Willd.	Swamp white oak
Q. lyrata Walter	Overcup oak
Q. michauxii Nutt.	Swamp chestnut oak
Rumex mexicanus Meisn.	Mexican dock
Ruppia spp.	Ditch grasses
R. maritima L.	Widgeon grass

Scientific Name	Common Name
Sagittaria spp.	Arrowheads
Salicornia spp.	Glassworts
S. depressa Standl.	Woody saltwort
Salix spp.	Willows
Salvinia spp.	Water mosses
Schoenoplectus acutus (Muhl. *ex* Bigelow) A. & D. Love	Hardstem club-rush
Scirpus spp.	Bulrushes
Scolochloa festucacea (Willd.) Link	Common river grass
Sparganium hyperboreum Beurling *ex* Laestad.	Bur-reed
Spartina alterniflora Loiseleur	Saltmarsh cordgrass
S. cynosuroides (L.) Roth	Big cordgrass
S. foliosa Trin.	California cordgrass
S. patens (Ait.) Muhl.	Saltmeadow cordgrass
Sphagnum spp.	Peat mosses
Spiraea douglasii Hook.	Douglas' meadowsweet
Spirodela spp.	Big duckweeds
Suaeda californica S. Wats.	Broom seepweed
Tamarix gallica L.	French tamarisk
Taxodium distichum (L.) L. C. Rich.	Southern bald-cypress
Thalassia testudinum Banks & Soland. *ex* Koenig	Turtle grass
Thuja occidentalis L.	Eastern arborvitae
Tolypella spp.	Stoneworts
Trapa natans L.	Water chestnut
Triglochin maritima L.	Seaside arrow-grass
Typha spp.	Cattails
T. angustifolia L.	Narrow-leaved cattail
T. latifolia L.	Broad-leaved cattail
Ulmus americana L.	American elm
Ulva spp.	Sea lettuces
Utricularia spp.	Bladderworts
Vaccinium oxycoccos L.	Small cranberry
Vallisneria americana Michx.	Wild celery
Verrucaria spp.	Lichens

Scientific Name	Common Name
Wolffia spp.	Watermeals
Xanthium strumarium L.	Rough cocklebur
Zannichellia palustris L.	Horned pondweed
Zenobia pulverulenta (W. Bartram) Pollard	Honeycup
Zizaniopsis miliacea (Michx.) Doell & Aschers.	Marsh-millet
Zostera marina L.	Eelgrass

APPENDIX D (Informative): Scientific and Common Names of Animals

Scientific and Common Names of Animals[1]

Scientific Name	Common Name
Acmaea spp.	Limpets
Acropora spp.	Staghorn corals
Agrenia spp.	Springtails
Amphipholis spp.	Brittle stars
Amphitrite spp.	Terebellid worms
Ancylus spp.	Freshwater limpet
Anodonta spp.	Freshwater mussel
Anodontoides spp.	Freshwater mussel
Anopheles spp.	Mosquitoes
Aplexa spp.	Pouch snails
Arenicola spp.	Lugworms
Asellus spp.	Aquatic sowbug
Baetis spp.	Mayflies
Balanus spp.	Acorn barnacles
Bryocamptus spp.	Harpacticoid copepods
Caenis spp.	Mayflies
Callianassa spp.	Ghost shrimp
Crassostrea spp.	Oysters
C. virginica (Geml.)	Eastern oyster
Dendraster spp.	Sand dollars
Diamesa spp.	Midges
Donax spp.	Wedge bean clams
Echinocardium spp.	Heart urchins
Elliptio spp.	Freshwater mussel
Emerita spp.	Mole crabs
Ephemerella spp.	Mayflies
Erpobdella spp.	Leeches
Eukiefferiella spp.	Midges
Eunapius spp.	Freshwater sponges
Euzonus spp.	Blood worms
Gammarus spp.	Scuds
Gelastocoris spp.	Toad bugs
Gordonia ventalina L.	Common sea fans

[1] Scientific names validated against the Integrated Taxonomic Information System (ITIS) on 2/17/2012 at http://www.itis.gov/.

Scientific Name	**Common Name**
Helobdella spp.	Leeches
Heteromeyenia spp.	Horse sponges
Hippospongia spp.	Encrusting sponges
Homarus americanus Milne-Edwards	American lobsters
Hydropsyche spp.	Caddisflies
Lampsilis spp.	Freshwater mussel
Ligia spp.	Sea
Limnodrilus spp.	Oligochaete black worm
Littorina spp.	Periwinkles
Lumbriculus spp.	Oligochaete worms
Lymnaea spp.	Pond snails
Macoma spp.	Macomas
M. balthica (Linne)	Baltic macoma
Melita spp.	Amphipods
Mercenaria spp.	Quahogs
Modiolus spp.	Horse
Montipora spp.	Corals
Muricea spp.	Sea whips
Mya spp.	Soft-shell clams
Mytilus spp.	Mussels
Nassarius spp.	Sand snails
Nemoura spp.	Stone flies
Nereis spp.	Clam worms
Nerita spp.	Black nerites
Notonecta spp.	Common ackswimmer
Oliva spp.	Olive shells
Orchestia spp.	Beach sand flea
Ostrea spp.	Oysters
Parastenocaris spp.	Copepods
Patella spp.	Limpets
Pecten spp.	Scallops
Petricola pholadiformis Lam.	False angel wings
Phyllognathopus viguieri Maryek	Copepods
Physa spp.	Bladder snail
Pisaster spp.	Sea stars
Pisidium spp.	Fingernail clams
Placopecten spp.	Deep-sea scallops
Platyodon spp.	Boring clams
Pollicipes spp.	Gooseneck barnacles

Scientific Name	Common Name
Porites spp.	Finger corals
Pristina spp.	Oligochaete worms
Procambarus spp.	Crayfish
Psephenus spp.	Water penny beetles
Renilla spp.	Sea pansies
Sabellaria spp.	Encrusted sand tubedworms
Saldula spp.	Shore bugs
Saxidomus spp.	Venus clams
Simulium spp.	Black flies
Siphonaria spp.	False limpets
Sphaerium spp.	Fingernail clams
Spongilla spp.	Freshwater sponges
Strongylocentrotus spp.	Sea urchins
Tabanus spp.	Flies
Tellina spp.	Tellin shells
Tetraclita spp.	Thatched barnacles
Thais spp.	Rock snails
Thyone spp.	Sea cucumbers
Tivela stultorum (Mawe)	Pismo clams
Tortopus spp.	Mayflies
Tubifex spp.	Sewage worms
Uca spp.	Fiddler crabs
Urechis spp.	Echiurid worms

APPENDIX E (Normative): Criteria for Differentiating between Mineral Soils and Organic Soils

Criteria for Differentiating between Mineral Soils[1] and Organic Soils

Note: We use the Soil Modifiers, Mineral and Organic, in this classification. Mineral soils and organic soils are differentiated based on specific criteria that are enumerated in Soil Taxonomy (Soil Survey Staff 1999:19-20). These criteria are restated below for ready reference. If a more detailed classification is desired, the latest edition of Keys to Soil Taxonomy (Soil Survey Staff 2010) should be used.

Soil taxonomy differentiates between mineral soils and organic soils. To do this, it is necessary to distinguish mineral soil material from organic soil material. Second, it is necessary to define the minimum part of a soil that should be mineral if a soil is to be classified as a mineral soil and the minimum part that should be organic if the soil is to be classified as an organic soil.

Nearly all soils contain more than traces of both mineral and organic components in some horizons, but most soils are dominantly one or the other. The horizons that are less than about 20 to 35 percent organic matter, by weight, have properties that are more nearly those of mineral than of organic soils. Even with this separation, the volume of organic matter at the upper limit exceeds that of the mineral material in the fine-earth fraction.

Mineral Soil Material

Mineral soil material (less than 2.0 mm in diameter) *either*:

1. Is saturated with water for less than 30 days (cumulative) per year in normal years and contains less than 20 percent (by weight) organic carbon; *or*

2. Is saturated with water for 30 days or more cumulative in normal years (or is artificially drained) and, excluding live roots, has an organic carbon content (by weight) of:

   a. Less than 18 percent if the mineral fraction contains 60 percent or more clay; *or*

   b. Less than 12 percent if the mineral fraction contains no clay; *or*

   c. Less than 12 + (clay percentage multiplied by 0.1) percent if the mineral fraction contains less than 60 percent clay.

Organic Soil Material

Soil material that contains more than the amounts of organic carbon described above for mineral soil material is considered organic soil material.

[1] Mineral soils include all soil except the suborder Histels and the order Histosols.

In the definition of mineral soil material above, material that has more organic carbon than in item 1 is intended to include what has been called litter or an O horizon. Material that has more organic carbon than in item 2 has been called peat or muck. Not all organic soil material accumulates in or under water. Leaf litter may rest on a lithic contact and support forest vegetation. The soil in this situation is organic only in the sense that the mineral fraction is appreciably less than half the weight and is only a small percentage of the volume of the soil.

Distinction between Mineral Soils and Organic Soils

Most soils are dominantly mineral material, but many mineral soils have horizons of organic material. For simplicity in writing definitions of taxa, a distinction between what is meant by a mineral soil and an organic soil is useful. To apply the definitions of many taxa, one must first decide whether the soil is mineral or organic. An exception is the Andisols (defined later). These generally are considered to consist of mineral soils, but some may be organic if they meet other criteria for Andisols. Those that exceed the organic carbon limit defined for mineral soils have a colloidal fraction dominated by short-range-order minerals or aluminum-humus complexes. The mineral fraction in these soils is believed to give more control to the soil properties than the organic fraction. Therefore, the soils are included with the Andisols rather than the organic soils defined later as Histosols.

If a soil has both organic and mineral horizons, the relative thickness of the organic and mineral soil materials must be considered. At some point one must decide that the mineral horizons are more important. This point is arbitrary and depends in part on the nature of the materials. A thick layer of sphagnum has a very low bulk density and contains less organic matter than a thinner layer of well-decomposed muck. It is much easier to measure the thickness of layers in the field than it is to determine tons of organic matter per hectare. The definition of a mineral soil, therefore, is based on thickness of the horizons, or layers, but the limits of thickness must vary with the kinds of materials. The definition that follows is intended to classify as mineral soils those that have both thick mineral soils layers and no more organic material than the amount permitted in the histic epipedon, which is defined in chapter 4.

In the determination of whether a soil is organic or mineral, the thickness of horizons is measured from the surface of the soil whether that is the surface of a mineral or an organic horizon, unless the soil is buried as defined in chapter 1. Thus, any O horizon at the surface is considered an organic horizon if it meets the requirements of organic soil material as defined later, and its thickness is added to that of any other organic horizons to determine the total thickness of organic soil materials.

Definition of Mineral Soils

Mineral soils are soils that have *either* of the following:

1. Mineral soil materials that meet *one or more* of the following:

a. Overlie cindery, fragmental, or pumiceous materials and/or have voids[2] that are filled with 10 percent or less organic materials *and* directly below these materials have either a densic, lithic, or paralithic contact; *or*

b. When added with underlying cindery, fragmental, or pumiceous materials, total more than 10 cm between the soil surface and a depth of 50 cm; *or*

c. Constitute more than one-third of the total thickness of the soil to a densic, lithic, or paralithic contact or have a total thickness of more than 10 cm; *or*

d. If they are saturated with water for 30 days or more per year in normal years (or are artificially drained) and have organic materials with an upper boundary within 40 cm of the soil surface, have a total thickness of *either:*

(1) Less than 60 cm if three-fourths or more of their volume consists of moss fibers or if their bulk density, moist, is less than 0.1 g/cm^3 *or*

(2) Less than 40 cm if they consist either of sapric or hemic materials, or of fibric materials with less than three-fourths (by volume) moss fibers and a bulk density, moist, of 0.1 g/cm^3 or more; *or*

2. More than 20 percent, by volume, mineral soil materials from the soil surface to a depth of 50 cm or to a glacic layer or a densic, lithic, or paralithic contact, whichever is shallowest; *and*

a. Permafrost within 100 cm of the soil surface; *or*

b. Gelic materials within 100 cm of the soil surface and permafrost within 200 cm of the soil surface.

[2] Materials that meet the definition of cindery, fragmental, or pumiceous but have more than 10 percent, by volume, voids that are filled with organic soil materials are considered to be organic soil materials.

Definition of Organic Soils

Organic soils have organic soil materials that:

1. Do not have andic soil properties in 60 percent or more of the thickness between the soil surface and either a depth of 60 cm or a densic, lithic, or paralithic contact or duripan if shallower; *and*

2. Meet *one or more* of the following:

    a. Overlie cindery, fragmental, or pumiceous materials and/or fill their interstices and directly below these materials have a densic, lithic, or paralithic contact; *or*

    b. When added with the underlying cindery, fragmental, or pumiceous materials, total 40 cm or more between the soil surface and a depth of 50 cm; *or*

    c. Constitute two-thirds or more of the total thickness of the soil to a densic, lithic, or paralithic contact *and* have no mineral horizons or have mineral horizons with a total thickness of 10 cm or less; *or*

    d. Are saturated with water for 30 days or more per year in normal years (or are artificially drained), have an upper boundary within 40 cm of the soil surface, and have a total thickness of *either:*

        (1) 60 cm or more if three-fourths or more of their volume consists of moss fibers or if their bulk density, moist, is less than 0.1 g/cm^3; *or*

        (2) 40 cm or more if they consist either of sapric or hemic materials, or of fibric materials with less than three-fourths (by volume) moss fibers and a bulk density, moist, of 0.1 g/cm^3 or more; *or*

    e. Are 80 percent or more, by volume, from the soil surface to a depth of 50 cm or to a glacic layer or a densic, lithic, or paralithic contact, whichever is shallowest.

It is a general rule that a soil is classified as an organic soil (Histosol) if more than half of the upper 80 cm (32 in) of the soil is organic or if organic soil material of any thickness rests on rock or on fragmental material having interstices filled with organic materials.

APPENDIX F (Informative): Regionalization for the Classification System

Regionalization for the Classification System

In this wetlands and deepwater classification, a given taxon has no particular regional alliance; its representatives may be found in one or many parts of the U.S. However, regional variations in climate, geology, soils, and vegetation are important in the development of different habitats, and management problems often differ greatly among regions. For these reasons, there is a need to recognize regional differences. Regionalization is designed to facilitate three activities: (1) planning, where it is necessary to study management problems and potential solutions on a regional basis; (2) organization and retrieval of data gathered in a resource inventory; and (3) interpretation of inventory data, including differences in indicator plants and animals among the regions.

In 1977 the USFWS adopted Bailey's (1976) ecoregions to give the inland wetlands and deepwater habitats of the United States an ecological address (see Cowardin et al. 1979). In this Standard, the 1995 version of Bailey's system is to be used wherever there is a need for regionalization in the U.S. interior (see http://www.fs.fed.us/rm/ecoregions/products/map-ecoregions-united-states#).

Bailey's approach is based on understanding the role of climate in ecosystem differentiation. To a considerable extent, climatic factors determine the boundaries of ecosystems at all scales. This will be more important going forward. The most important of these is climatic regime, defined as the diurnal and seasonal fluxes of energy and moisture. As these fluxes change, the kinds and patterns of dominant life forms of plants and animals change and, over the course of centuries, the kinds of soils and water bodies. As a result, ecosystems of different climates differ significantly. The areas they occupy are not terrestrial or aquatic, but geographical, ecosystem units. Controls over the climatic effect change with scale. Understanding these controlling factors on a scale-related basis is key to setting ecosystem boundaries.

As with the wetlands and deepwater classification system, Bailey's classification of ecoregions is hierarchical. The upper four levels are *domain* (defined as including subcontinental areas of related climates), *division* (defined as including regional climate at the level of Köppen's [1931] types), *province* (defined as including broad plant formations), and *section* (defined on the basis of physiography by Bailey et al. [1994] and revised by Cleland et al. [2005] for the conterminous U.S. and Nowacki and Brock [1995] for Alaska). Mountainous provinces and sections exhibiting altitudinal zonation and having the climatic regime of the adjacent lowlands are distinguished according to the character of the zonation. On the map, ecoregion sections within each ecoregion province are shown in the same color and the sections are numbered with an alphanumeric code; numbers 1 through 3 represent the first three levels in the hierarchy. The numbers are followed by a capital letter representing the fourth level. The codes for mountains are preceded by the letter "M." The reader is referred to Bailey (1995, 2005) and McNab et al. (2005) for detailed discussion and description of the units appearing on this map, reproduced in Figure 7.

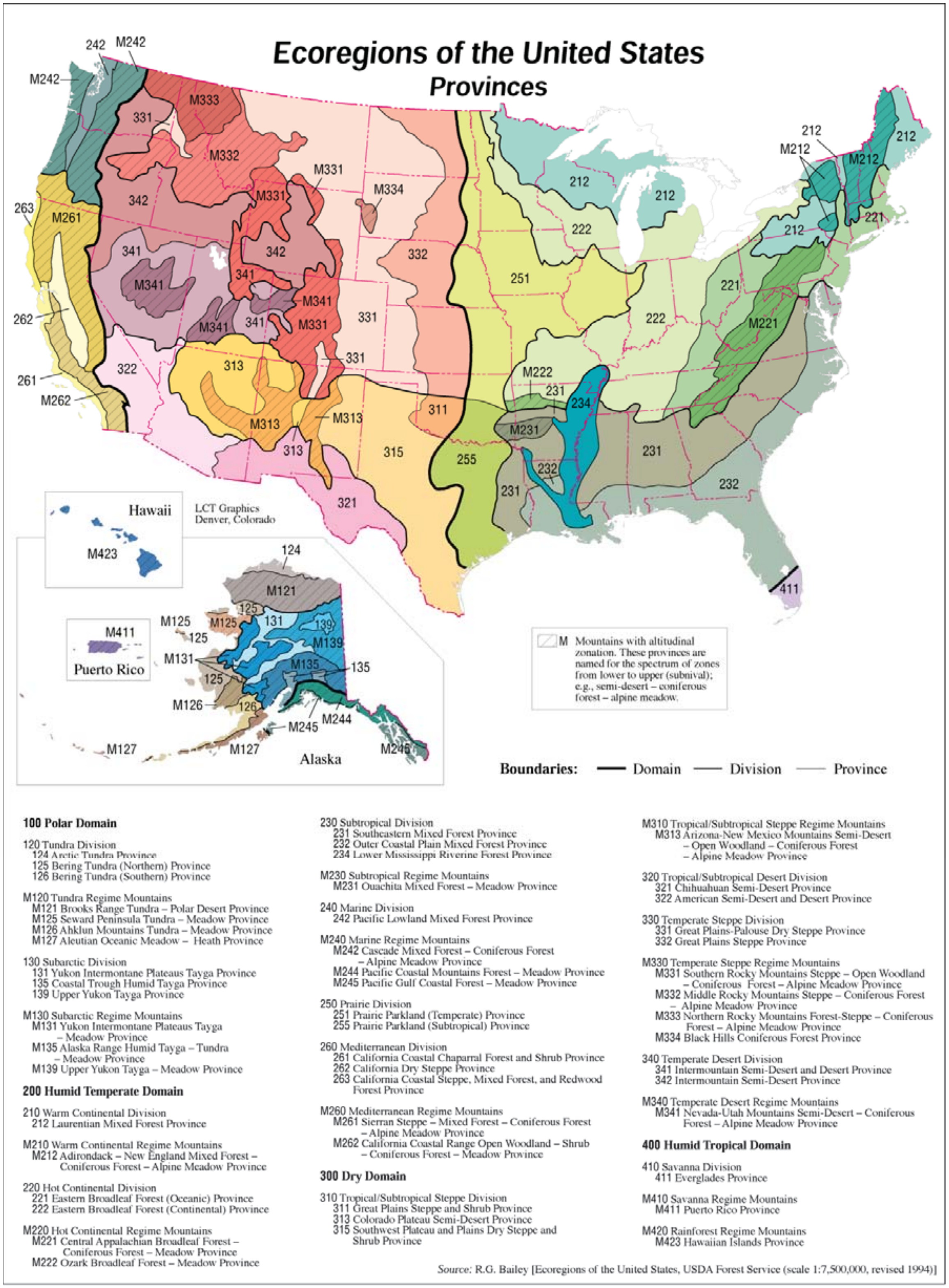

Figure 7. Ecoregions of the United States.

APPENDIX G (Informative): Wetland Image Gallery

Wetland Image Gallery

http://www.wetlandgallery.cnlworld.org

The Wetland Image Gallery is a compilation of images that illustrate the types of wetlands and deepwater habitats in the United States. Established in 2010, it helps users to visualize, and better understand, the great diversity of wet habitats in this country. The general public, government personnel, wetland scientists, geographers, environmentalists, and other interested parties may contribute to the Wetland Image Gallery. This is a crowd-sourcing source effort, with all of its inherent advantages and disadvantages. The intent is to continuously update and add new images to complement the Wetlands Classification Standard (FGDC-STD-004-2013), the Wetlands Mapping Standard (FGDC-STD-015-2009) and the National Wetlands Inventory's Data Collection Requirements and Procedures document (Dahl et al. 2009).

Reference 19

Species Information

Species observations for selected counties

Linked life history provided courtesy of NatureServe Explorer .
Records may include both recent and historical observations.
US Status Definitions Kentucky Status Definitions

List Species observations in 1 selected county.
Selected county is: Shelby.

Scientific Name and Life History	Common Name and Pictures	Class	County	US Status	KY Status	WAP	Reference
Accipiter cooperii	Cooper's Hawk	Aves	Shelby	N	N		Reference
Accipiter striatus	Sharp-shinned Hawk	Aves	Shelby	N	S	Yes	Reference
Acris blanchardi	Blanchard's Cricket Frog	Amphibia	Shelby	N	N		Reference
Acris crepitans	Northern Cricket Frog	Amphibia	Shelby	N	N		Reference
Actinonaias ligamentina	Mucket	Bivalvia	Shelby	N	N		Reference
Actitis macularius	Spotted Sandpiper	Aves	Shelby	N	E	Yes	Reference
Agelaius phoeniceus	Red-winged Blackbird	Aves	Shelby	N	N		Reference
Aix sponsa	Wood Duck	Aves	Shelby	N	N		Reference
Alasmidonta viridis	Slippershell Mussel	Bivalvia	Shelby	N	N	Yes	Reference
Alosa chrysochloris	Skipjack Herring	Actinopterygii	Shelby	N	N		Reference

Ambloplites rupestris	Rock Bass	Actinopterygii	Shelby	N	N		Reference
Ambystoma barbouri	Streamside Salamander	Amphibia	Shelby	N	N	Yes	Reference
Ambystoma jeffersonianum	Jefferson Salamander	Amphibia	Shelby	N	N		Reference
Ambystoma opacum	Marbled Salamander	Amphibia	Shelby	N	N		Reference
Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	Amphibia	Shelby	N	N		Reference
Ameiurus melas	Black Bullhead	Actinopterygii	Shelby	N	N		Reference
Ameiurus natalis	Yellow Bullhead	Actinopterygii	Shelby	N	N		Reference
Ameiurus nebulosus	Brown Bullhead	Actinopterygii	Shelby	N	N		Reference
Ammodramus henslowii	Henslow's Sparrow	Aves	Shelby	N	S	Yes	Reference
Ammodramus savannarum	Grasshopper Sparrow	Aves	Shelby	N	N	Yes	Reference
Amphiuma tridactylum	Three-toed Amphiuma	Amphibia	Shelby	N	E	Yes	Reference
Anas clypeata	Northern Shoveler	Aves	Shelby	N	E		Reference
Anas crecca	Green-winged Teal	Aves	Shelby	N	N		Reference
Anas discors	Blue-winged Teal	Aves	Shelby	N	T		Reference
Anas platyrhynchos	Mallard	Aves	Shelby	N	N		Reference
Anas rubripes	American Black Duck	Aves	Shelby	N	N	Yes	Reference
Anas strepera	Gadwall	Aves	Shelby	N	N		Reference

Anser albifrons	Greater White-fronted Goose	Aves	Shelby	N	N		Reference
Antigone canadensis	Sandhill Crane	Aves	Shelby	N	N	Yes	Reference
Antrostomus vociferus	Eastern Whip-poor-will	Aves	Shelby	N	N	Yes	Reference
Apalone spinifera spinifera	Eastern Spiny Softshell Turtle	Reptilia	Shelby	N	N		Reference
Aplodinotus grunniens	Freshwater Drum	Actinopterygii	Shelby	N	N		Reference
Archilochus colubris	Ruby-throated Hummingbird	Aves	Shelby	N	N		Reference
Ardea herodias	Great Blue Heron	Aves	Shelby	N	N		Reference
Asio flammeus	Short-eared Owl	Aves	Shelby	N	E	Yes	Reference
Asio otus	Long-eared Owl	Aves	Shelby	N	E	Yes	Reference
Aythya americana	Redhead	Aves	Shelby	N	N		Reference
Aythya collaris	Ring-necked Duck	Aves	Shelby	N	N		Reference
Aythya valisineria	Canvasback	Aves	Shelby	N	N		Reference
Baeolophus bicolor	Tufted Titmouse	Aves	Shelby	N	N		Reference
Blarina brevicauda	Northern Short-tailed Shrew	Mammalia	Shelby	N	N		Reference
Bombycilla cedrorum	Cedar Waxwing	Aves	Shelby	N	N		Reference
Branta canadensis	Canada Goose	Aves	Shelby	N	N		Reference
Branta hutchinsii	Cackling Goose	Aves	Shelby	N	N		Reference

Bubo virginianus	Great Horned Owl	Aves	Shelby	N	N		Reference
Bucephala albeola	Bufflehead	Aves	Shelby	N	N		Reference
Bucephala clangula	Common Goldeneye	Aves	Shelby	N	N		Reference
Bufo americanus	American Toad	Amphibia	Shelby	N	N		Reference
Bufo fowleri	Fowler's Toad	Amphibia	Shelby	N	N		Reference
Buteo jamaicensis	Red-tailed Hawk	Aves	Shelby	N	N		Reference
Buteo lineatus	Red-shouldered Hawk	Aves	Shelby	N	N		Reference
Buteo platypterus	Broad-winged Hawk	Aves	Shelby	N	N		Reference
Butorides virescens	Green Heron	Aves	Shelby	N	N		Reference
Calcarius lapponicus	Lapland Longspur	Aves	Shelby	N	N		Reference
Calidris melanotos	Pectoral Sandpiper	Aves	Shelby	N	N		Reference
Calidris minutilla	Least Sandpiper	Aves	Shelby	N	N		Reference
Cambarus tenebrosus	Cavespring Crayfish	Malacostraca	Shelby	N	N		Reference
Cambarus thomai	Little Brown Mudbug	Malacostraca	Shelby	N	N		Reference
Campostoma anomalum	Central Stoneroller	Actinopterygii	Shelby	N	N		Reference
Campostoma oligolepis	Largescale Stoneroller	Actinopterygii	Shelby	N	N		Reference
Canis latrans	Coyote	Mammalia	Shelby	N	N		Reference
Carassius auratus	Goldfish	Actinopterygii	Shelby	N	N		Reference

Cardinalis cardinalis	Northern Cardinal	Aves	Shelby	N	N		Reference
Carpiodes carpio	River Carpsucker	Actinopterygii	Shelby	N	N		Reference
Carpiodes cyprinus	Quillback	Actinopterygii	Shelby	N	N		Reference
Carpiodes velifer	Highfin Carpsucker	Actinopterygii	Shelby	N	N		Reference
Castor canadensis	American Beaver	Mammalia	Shelby	N	N		Reference
Cathartes aura	Turkey Vulture	Aves	Shelby	N	N		Reference
Catostomus commersonii	White Sucker	Actinopterygii	Shelby	N	N		Reference
Chaetura pelagica	Chimney Swift	Aves	Shelby	N	N		Reference
Charadrius vociferus	Killdeer	Aves	Shelby	N	N		Reference
Chelydra serpentina serpentina	Common Snapping Turtle	Reptilia	Shelby	N	N		Reference
Chen caerulescens	Snow Goose	Aves	Shelby	N	N		Reference
Chondestes grammacus	Lark Sparrow	Aves	Shelby	N	T	Yes	Reference
Chordeiles minor	Common Nighthawk	Aves	Shelby	N	N		Reference
Chrysemys picta	Painted Turtle	Reptilia	Shelby	N	N		Reference
Coccothraustes vespertinus	Evening Grosbeak	Aves	Shelby	N	N		Reference
Coccyzus americanus	Yellow-billed Cuckoo	Aves	Shelby	N	N		Reference
Coccyzus erythropthalmus	Black-billed Cuckoo	Aves	Shelby	N	N		Reference
Colaptes auratus	Northern Flicker	Aves	Shelby	N	N		Reference

Colinus virginianus	Northern Bobwhite	Aves	Shelby	N	N	Yes	Reference
Coluber constrictor	Racer	Reptilia	Shelby	N	N		Reference
Columba livia	Rock Pigeon	Aves	Shelby	N	N		Reference
Contopus virens	Eastern Wood-Pewee	Aves	Shelby	N	N		Reference
Coragyps atratus	Black Vulture	Aves	Shelby	N	N		Reference
Corbicula fluminea	Asian Clam	Bivalvia	Shelby	N	N		Reference
Corvus brachyrhynchos	American Crow	Aves	Shelby	N	N		Reference
Cottus carolinae	Banded Sculpin	Actinopterygii	Shelby	N	N		Reference
Cryptotis parva	Least Shrew	Mammalia	Shelby	N	N		Reference
Ctenopharyngodon idella	Grass Carp	Actinopterygii	Shelby	N	N		Reference
Cyanocitta cristata	Blue Jay	Aves	Shelby	N	N		Reference
Cygnus olor	Mute Swan	Aves	Shelby	N	N		Reference
Cyprinella spiloptera	Spotfin Shiner	Actinopterygii	Shelby	N	N		Reference
Cyprinella whipplei	Steelcolor Shiner	Actinopterygii	Shelby	N	N		Reference
Cyprinus carpio	Common Carp	Actinopterygii	Shelby	N	N		Reference
Dasypus novemcinctus	Nine-banded Armadillo	Mammalia	Shelby	N	N		Reference
Diadophis punctatus	Ringneck Snake	Reptilia	Shelby	N	N		Reference
Didelphis virginiana	Virginia Opossum	Mammalia	Shelby	N	N		Reference
Dolichonyx oryzivorus	Bobolink	Aves	Shelby	N	S	Yes	Reference
Dorosoma cepedianum	Gizzard Shad	Actinopterygii	Shelby	N	N		Reference

Dryocopus pileatus	Pileated Woodpecker	Aves	Shelby	N	N		Reference
Dumetella carolinensis	Gray Catbird	Aves	Shelby	N	N		Reference
Elaphe obsoleta obsoleta	Black Rat Snake	Reptilia	Shelby	N	N		Reference
Elimia semicarinata	Fine-ridged Elimia	Gastropoda	Shelby	N	N		Reference
Empidonax flaviventris	Yellow-bellied Flycatcher	Aves	Shelby	N	N		Reference
Empidonax traillii	Willow Flycatcher	Aves	Shelby	N	N	Yes	Reference
Empidonax virescens	Acadian Flycatcher	Aves	Shelby	N	N		Reference
Eremophila alpestris	Horned Lark	Aves	Shelby	N	N		Reference
Esox americanus	Redfin Or Grass Pickerel	Actinopterygii	Shelby	N	N		Reference
Etheostoma blennioides	Greenside Darter	Actinopterygii	Shelby	N	N		Reference
Etheostoma caeruleum	Rainbow Darter	Actinopterygii	Shelby	N	N		Reference
Etheostoma flabellare	Fantail Darter	Actinopterygii	Shelby	N	N		Reference
Etheostoma lawrencei	Headwater Darter	Actinopterygii	Shelby	N	N		Reference
Etheostoma nigrum	Johnny Darter	Actinopterygii	Shelby	N	N		Reference
Etheostoma spectabile	Orangethroat Darter	Actinopterygii	Shelby	N	N		Reference
Etheostoma zonale	Banded Darter	Actinopterygii	Shelby	N	N		Reference
Eumeces fasciatus	Five-lined Skink	Reptilia	Shelby	N	N		Reference

Eumeces laticeps	Broadhead Skink	Reptilia	Shelby	N	N		Reference
Euphagus carolinus	Rusty Blackbird	Aves	Shelby	N	N	Yes	Reference
Eurycea cirrigera	Southern Two-lined Salamander	Amphibia	Shelby	N	N		Reference
Eurycea lucifuga	Cave Salamander	Amphibia	Shelby	N	N		Reference
Falco columbarius	Merlin	Aves	Shelby	N	N		Reference
Falco sparverius	American Kestrel	Aves	Shelby	N	N	Yes	Reference
Ferrissia rivularis	Creeping Ancylid	Gastropoda	Shelby	N	N		Reference
Fulica americana	American Coot	Aves	Shelby	N	E		Reference
Fundulus notatus	Blackstripe Topminnow	Actinopterygii	Shelby	N	N		Reference
Fusconaia flava	Wabash Pigtoe	Bivalvia	Shelby	N	N		Reference
Gambusia affinis	Western Mosquitofish	Actinopterygii	Shelby	N	N		Reference
Geothlypis formosa	Kentucky Warbler	Aves	Shelby	N	N	Yes	Reference
Geothlypis trichas	Common Yellowthroat	Aves	Shelby	N	N		Reference
Haemorhous mexicanus	House Finch	Aves	Shelby	N	N		Reference
Haemorhous purpureus	Purple Finch	Aves	Shelby	N	N		Reference
Haliaeetus leucocephalus	Bald Eagle	Aves	Shelby	N	T	Yes	Reference
Helisoma anceps	Two-ridged Rams-horn	Gastropoda	Shelby	N	N		Reference

Helmitheros vermivorum	Worm-eating Warbler	Aves	Shelby	N	N	Yes	Reference
Heterodon platirhinos	Eastern Hognose Snake	Reptilia	Shelby	N	N		Reference
Hirundo rustica	Barn Swallow	Aves	Shelby	N	N		Reference
Hybopsis amblops	Bigeye Chub	Actinopterygii	Shelby	N	N		Reference
Hyla chrysoscelis	Cope's Gray Treefrog	Amphibia	Shelby	N	N		Reference
Hylocichla mustelina	Wood Thrush	Aves	Shelby	N	N	Yes	Reference
Hypentelium nigricans	Northern Hog Sucker	Actinopterygii	Shelby	N	N		Reference
Ictalurus punctatus	Channel Catfish	Actinopterygii	Shelby	N	N		Reference
Icteria virens	Yellow-breasted Chat	Aves	Shelby	N	N		Reference
Icterus galbula	Baltimore Oriole	Aves	Shelby	N	N		Reference
Icterus spurius	Orchard Oriole	Aves	Shelby	N	N		Reference
Junco hyemalis	Dark-eyed Junco	Aves	Shelby	N	S		Reference
Labidesthes sicculus	Brook Silverside	Actinopterygii	Shelby	N	N		Reference
Lampropeltis triangulum	Milk Snake	Reptilia	Shelby	N	N		Reference
Lampsilis cardium	Plain Pocketbook	Bivalvia	Shelby	N	N		Reference
Lampsilis siliquoidea	Fatmucket	Bivalvia	Shelby	N	N		Reference
Lanius ludovicianus	Loggerhead Shrike	Aves	Shelby	N	N	Yes	Reference
Lasiurus borealis	Eastern Red Bat	Mammalia	Shelby	N	N		Reference

Lasmigona complanata complanata	White Heelsplitter	Bivalvia	Shelby	N	N		Reference
Lasmigona costata	Flutedshell	Bivalvia	Shelby	N	N		Reference
Lepomis cyanellus	Green Sunfish	Actinopterygii	Shelby	N	N		Reference
Lepomis gulosus	Warmouth	Actinopterygii	Shelby	N	N		Reference
Lepomis humilis	Orangespotted Sunfish	Actinopterygii	Shelby	N	N		Reference
Lepomis macrochirus	Bluegill	Actinopterygii	Shelby	N	N		Reference
Lepomis megalotis	Longear Sunfish	Actinopterygii	Shelby	N	N		Reference
Lepomis microlophus	Redear Sunfish	Actinopterygii	Shelby	N	N		Reference
Leptodea fragilis	Fragile Papershell	Bivalvia	Shelby	N	N		Reference
Lontra canadensis	Northern River Otter	Mammalia	Shelby	N	N		Reference
Luxilus chrysocephalus	Striped Shiner	Actinopterygii	Shelby	N	N		Reference
Lynx rufus	Bobcat	Mammalia	Shelby	N	N		Reference
Lythrurus fasciolaris	Scarlet Shiner	Actinopterygii	Shelby	N	N		Reference
Marmota monax	Woodchuck	Mammalia	Shelby	N	N		Reference
Megaceryle alcyon	Belted Kingfisher	Aves	Shelby	N	N		Reference
Megascops asio	Eastern Screech-Owl	Aves	Shelby	N	N		Reference
Melanerpes carolinus	Red-bellied Woodpecker	Aves	Shelby	N	N		Reference
Melanerpes erythrocephalus	Red-headed Woodpecker	Aves	Shelby	N	N	Yes	Reference

Meleagris gallopavo	Wild Turkey	Aves	Shelby	N	N		Reference
Melospiza georgiana	Swamp Sparrow	Aves	Shelby	N	N		Reference
Melospiza melodia	Song Sparrow	Aves	Shelby	N	N		Reference
Mephitis mephitis	Striped Skunk	Mammalia	Shelby	N	N		Reference
Micropterus dolomieu	Smallmouth Bass	Actinopterygii	Shelby	N	N		Reference
Micropterus punctulatus	Spotted Bass	Actinopterygii	Shelby	N	N		Reference
Micropterus salmoides	Largemouth Bass	Actinopterygii	Shelby	N	N		Reference
Microtus ochrogaster	Prairie Vole	Mammalia	Shelby	N	N		Reference
Microtus pinetorum	Woodland Vole	Mammalia	Shelby	N	N		Reference
Mimus polyglottos	Northern Mockingbird	Aves	Shelby	N	N		Reference
Minytrema melanops	Spotted Sucker	Actinopterygii	Shelby	N	N		Reference
Mniotilta varia	Black-and-white Warbler	Aves	Shelby	N	N		Reference
Molothrus ater	Brown-headed Cowbird	Aves	Shelby	N	N		Reference
Morone chrysops	White Bass	Actinopterygii	Shelby	N	N		Reference
Morone mississippiensis	Yellow Bass	Actinopterygii	Shelby	N	N		Reference
Moxostoma carinatum	River Redhorse	Actinopterygii	Shelby	N	N		Reference
Moxostoma duquesnei	Black Redhorse	Actinopterygii	Shelby	N	N		Reference
Moxostoma erythrurum	Golden Redhorse	Actinopterygii	Shelby	N	N		Reference

Musculium transversum	Long Fingernailclam	Bivalvia	Shelby	N	N		Reference
Mustela nivalis	Least Weasel	Mammalia	Shelby	N	S		Reference
Mustela vison	American Mink	Mammalia	Shelby	N	N		Reference
Myiarchus crinitus	Great Crested Flycatcher	Aves	Shelby	N	N		Reference
Myotis grisescens	Gray Myotis	Mammalia	Shelby	E	T	Yes	Reference
Myotis sodalis	Indiana Bat	Mammalia	Shelby	E	E	Yes	Reference
Necturus maculosus	Mudpuppy	Amphibia	Shelby	N	N		Reference
Nerodia sipedon	Northern Water Snake	Reptilia	Shelby	N	N		Reference
Notemigonus crysoleucas	Golden Shiner	Actinopterygii	Shelby	N	N		Reference
Notophthalmus viridescens	Eastern Newt	Amphibia	Shelby	N	N		Reference
Notropis atherinoides	Emerald Shiner	Actinopterygii	Shelby	N	N		Reference
Notropis boops	Bigeye Shiner	Actinopterygii	Shelby	N	N		Reference
Notropis buccatus	Silverjaw Minnow	Actinopterygii	Shelby	N	N		Reference
Notropis photogenis	Silver Shiner	Actinopterygii	Shelby	N	N		Reference
Notropis rubellus	Rosyface Shiner	Actinopterygii	Shelby	N	N		Reference
Notropis stramineus	Sand Shiner	Actinopterygii	Shelby	N	N		Reference
Notropis volucellus	Mimic Shiner	Actinopterygii	Shelby	N	N		Reference
Noturus flavus	Stonecat	Actinopterygii	Shelby	N	N		Reference
Noturus gyrinus	Tadpole Madtom	Actinopterygii	Shelby	N	N		Reference

Noturus miurus	Brindled Madtom	Actinopterygii	Shelby	N	N		Reference
Odocoileus virginianus	White-tailed Deer	Mammalia	Shelby	N	N		Reference
Ondatra zibethicus	Muskrat	Mammalia	Shelby	N	N		Reference
Opheodrys aestivus	Rough Green Snake	Reptilia	Shelby	N	N		Reference
Orconectes cristavarius	Spiny Stream Crayfish	Malacostraca	Shelby	N	N		Reference
Orconectes juvenilis	Kentucky River Crayfish	Malacostraca	Shelby	N	N		Reference
Orconectes putnami	Phallic Crayfish	Malacostraca	Shelby	N	N		Reference
Orconectes rusticus	Rusty Crayfish	Malacostraca	Shelby	N	N		Reference
Oreothlypis peregrina	Tennessee Warbler	Aves	Shelby	N	N		Reference
Oreothlypis ruficapilla	Nashville Warbler	Aves	Shelby	N	N		Reference
Pandion haliaetus	Osprey	Aves	Shelby	N	S	Yes	Reference
Parkesia motacilla	Louisiana Waterthrush	Aves	Shelby	N	N	Yes	Reference
Passer domesticus	House Sparrow	Aves	Shelby	N	N		Reference
Passerculus sandwichensis	Savannah Sparrow	Aves	Shelby	N	S	Yes	Reference
Passerella iliaca	Fox Sparrow	Aves	Shelby	N	N		Reference
Passerina caerulea	Blue Grosbeak	Aves	Shelby	N	N		Reference
Passerina cyanea	Indigo Bunting	Aves	Shelby	N	N		Reference
Pelecanus erythrorhynchos	American White Pelican	Aves	Shelby	N	N	Yes	Reference

Percina caprodes	Logperch	Actinopterygii	Shelby	N	N		Reference
Percina maculata	Blackside Darter	Actinopterygii	Shelby	N	N		Reference
Percopsis omiscomaycus	Trout-Perch	Actinopterygii	Shelby	N	S		Reference
Peromyscus leucopus	White-footed Mouse	Mammalia	Shelby	N	N		Reference
Petrochelidon pyrrhonota	Cliff Swallow	Aves	Shelby	N	N		Reference
Phalacrocorax auritus	Double-crested Cormorant	Aves	Shelby	N	T		Reference
Phenacobius mirabilis	Suckermouth Minnow	Actinopterygii	Shelby	N	N		Reference
Physa gyrina	Tadpole Physa	Gastropoda	Shelby	N	N		Reference
Picoides pubescens	Downy Woodpecker	Aves	Shelby	N	N		Reference
Picoides villosus	Hairy Woodpecker	Aves	Shelby	N	N		Reference
Pimephales notatus	Bluntnose Minnow	Actinopterygii	Shelby	N	N		Reference
Pimephales promelas	Fathead Minnow	Actinopterygii	Shelby	N	N		Reference
Pimephales vigilax	Bullhead Minnow	Actinopterygii	Shelby	N	N		Reference
Pipilo erythrophthalmus	Eastern Towhee	Aves	Shelby	N	N		Reference
Piranga olivacea	Scarlet Tanager	Aves	Shelby	N	N		Reference
Piranga rubra	Summer Tanager	Aves	Shelby	N	N		Reference
Platalea ajaja	Roseate Spoonbill	Aves	Shelby	N	N		Reference

Plegadis chihi	White-faced Ibis	Aves	Shelby	N	N		Reference
Plethodon dorsalis	Northern Zigzag Salamander	Amphibia	Shelby	N	N		Reference
Plethodon glutinosus	Slimy Salamander	Amphibia	Shelby	N	N		Reference
Plethodon richmondi	Ravine Salamander	Amphibia	Shelby	N	N		Reference
Pleurocera acuta	Sharp Hornsnail	Gastropoda	Shelby	N	N		Reference
Podilymbus podiceps	Pied-billed Grebe	Aves	Shelby	N	E	Yes	Reference
Poecile carolinensis	Carolina Chickadee	Aves	Shelby	N	N		Reference
Polioptila caerulea	Blue-gray Gnatcatcher	Aves	Shelby	N	N		Reference
Pomoxis annularis	White Crappie	Actinopterygii	Shelby	N	N		Reference
Pomoxis nigromaculatus	Black Crappie	Actinopterygii	Shelby	N	N		Reference
Potamilus alatus	Pink Heelsplitter	Bivalvia	Shelby	N	N		Reference
Procyon lotor	Northern Raccoon	Mammalia	Shelby	N	N		Reference
Progne subis	Purple Martin	Aves	Shelby	N	N		Reference
Pseudacris crucifer crucifer	Northern Spring Peeper	Amphibia	Shelby	N	N		Reference
Pseudacris triseriata	Western Chorus Frog	Amphibia	Shelby	N	N		Reference
Pyganodon grandis	Giant Floater	Bivalvia	Shelby	N	N		Reference
Pylodictis olivaris	Flathead Catfish	Actinopterygii	Shelby	N	N		Reference

Quiscalus quiscula	Common Grackle	Aves	Shelby	N	N		Reference
Rana catesbeiana	Bullfrog	Amphibia	Shelby	N	N		Reference
Rana clamitans melanota	Green Frog	Amphibia	Shelby	N	N		Reference
Rana palustris	Pickerel Frog	Amphibia	Shelby	N	N		Reference
Regina septemvittata	Queen Snake	Reptilia	Shelby	N	N		Reference
Regulus calendula	Ruby-crowned Kinglet	Aves	Shelby	N	N		Reference
Regulus satrapa	Golden-crowned Kinglet	Aves	Shelby	N	N		Reference
Sander canadensis	Sauger	Actinopterygii	Shelby	N	N		Reference
Sayornis phoebe	Eastern Phoebe	Aves	Shelby	N	N		Reference
Scalopus aquaticus	Eastern Mole	Mammalia	Shelby	N	N		Reference
Sceloporus undulatus	Fence Lizard	Reptilia	Shelby	N	N		Reference
Sciurus carolinensis	Eastern Gray Squirrel	Mammalia	Shelby	N	N		Reference
Sciurus niger	Eastern Fox Squirrel	Mammalia	Shelby	N	N		Reference
Scolopax minor	American Woodcock	Aves	Shelby	N	N	Yes	Reference
Seiurus aurocapilla	Ovenbird	Aves	Shelby	N	N		Reference
Selasphorus rufus	Rufous Hummingbird	Aves	Shelby	N	N		Reference
Semotilus atromaculatus	Creek Chub	Actinopterygii	Shelby	N	N		Reference
Setophaga americana	Northern Parula	Aves	Shelby	N	N		Reference

Setophaga citrina	Hooded Warbler	Aves	Shelby	N	N		Reference
Setophaga coronata	Yellow-rumped Warbler	Aves	Shelby	N	N		Reference
Setophaga discolor	Prairie Warbler	Aves	Shelby	N	N	Yes	Reference
Setophaga dominica	Yellow-throated Warbler	Aves	Shelby	N	N		Reference
Setophaga magnolia	Magnolia Warbler	Aves	Shelby	N	N		Reference
Setophaga palmarum	Palm Warbler	Aves	Shelby	N	N		Reference
Setophaga pensylvanica	Chestnut-sided Warbler	Aves	Shelby	N	N		Reference
Setophaga petechia	Yellow Warbler	Aves	Shelby	N	N		Reference
Setophaga pinus	Pine Warbler	Aves	Shelby	N	N		Reference
Setophaga striata	Blackpoll Warbler	Aves	Shelby	N	N		Reference
Sialia sialis	Eastern Bluebird	Aves	Shelby	N	N		Reference
Simpsonaias ambigua	Salamander Mussel	Bivalvia	Shelby	N	T	Yes	Reference
Sitta carolinensis	White-breasted Nuthatch	Aves	Shelby	N	N		Reference
Sorex longirostris	Southeastern Shrew	Mammalia	Shelby	N	N		Reference
Sphaerium fabale	River Fingernailclam	Bivalvia	Shelby	N	N		Reference
Sphaerium simile	Grooved Fingernailclam	Bivalvia	Shelby	N	N		Reference
Sphyrapicus varius	Yellow-bellied Sapsucker	Aves	Shelby	N	N		Reference

Spinus pinus	Pine Siskin	Aves	Shelby	N	N		Reference
Spinus tristis	American Goldfinch	Aves	Shelby	N	N		Reference
Spiza americana	Dickcissel	Aves	Shelby	N	N	Yes	Reference
Spizella passerina	Chipping Sparrow	Aves	Shelby	N	N		Reference
Spizella pusilla	Field Sparrow	Aves	Shelby	N	N		Reference
Spizelloides arborea	American Tree Sparrow	Aves	Shelby	N	N		Reference
Stelgidopteryx serripennis	Northern Rough-winged Swallow	Aves	Shelby	N	N		Reference
Sternotherus odoratus	Common Musk Turtle	Reptilia	Shelby	N	N		Reference
Streptopelia decaocto	Eurasian Collared-dove	Aves	Shelby	N	N		Reference
Strix varia	Barred Owl	Aves	Shelby	N	N		Reference
Strophitus undulatus	Creeper	Bivalvia	Shelby	N	N		Reference
Sturnella magna	Eastern Meadowlark	Aves	Shelby	N	N		Reference
Sturnus vulgaris	European Starling	Aves	Shelby	N	N		Reference
Sylvilagus floridanus	Eastern Cottontail	Mammalia	Shelby	N	N		Reference
Tachycineta bicolor	Tree Swallow	Aves	Shelby	N	N		Reference
Tamias striatus	Eastern Chipmunk	Mammalia	Shelby	N	N		Reference
Terrapene carolina carolina	Eastern Box Turtle	Reptilia	Shelby	N	N		Reference
Thamnophis sirtalis sirtalis	Eastern Garter Snake	Reptilia	Shelby	N	N		Reference

Thryothorus ludovicianus	Carolina Wren	Aves	Shelby	N	N		Reference
Toxolasma lividum	Purple Lilliput	Bivalvia	Shelby	N	E	Yes	Reference
Toxostoma rufum	Brown Thrasher	Aves	Shelby	N	N		Reference
Trachemys scripta elegans	Red-eared Slider	Reptilia	Shelby	N	N		Reference
Troglodytes aedon	House Wren	Aves	Shelby	N	N		Reference
Troglodytes hiemalis	Winter Wren	Aves	Shelby	N	N		Reference
Turdus migratorius	American Robin	Aves	Shelby	N	N		Reference
Tyrannus forficatus	Scissor-tailed Flycatcher	Aves	Shelby	N	N		Reference
Tyrannus tyrannus	Eastern Kingbird	Aves	Shelby	N	N		Reference
Tyto alba	Barn Owl	Aves	Shelby	N	S	Yes	Reference
Urocyon cinereoargenteus	Gray Fox	Mammalia	Shelby	N	N		Reference
Utterbackia imbecillis	Paper Pondshell	Bivalvia	Shelby	N	N		Reference
Vireo flavifrons	Yellow-throated Vireo	Aves	Shelby	N	N		Reference
Vireo gilvus	Warbling Vireo	Aves	Shelby	N	N		Reference
Vireo griseus	White-eyed Vireo	Aves	Shelby	N	N		Reference
Vireo olivaceus	Red-eyed Vireo	Aves	Shelby	N	N		Reference
Vireo solitarius	Blue-headed Vireo	Aves	Shelby	N	N		Reference
Vulpes vulpes	Red Fox	Mammalia	Shelby	N	N		Reference

Zenaida macroura	Mourning Dove	Aves	Shelby	N	N		Reference
Zonotrichia albicollis	White-throated Sparrow	Aves	Shelby	N	N		Reference
Zonotrichia leucophrys	White-crowned Sparrow	Aves	Shelby	N	N		Reference

333 species are listed

HRS Quick Score Notes—Shelby Industries

This scenario assumes an observed release. The Air Migration Pathway was not scored. The site score for the Worst Case Scenario is 2.02.

Source

The source used was contaminated soil. It is unlikely that the entire ~22 acre property is contaminated, the area of the former lagoons, pond, and possible capped area totals less than one (1) acre. The footprint of the on slab former factory building measures less than five (5) acres. Thus a total of six (6) acres was used in HRS calculations.

Hazardous Substances

Very limited sampling was done in 1983 and did not reveal soil contamination above MCLs. Assumptions related to hazardous substances were made based on available information and the operational history of the site. The site operated first as a non-cyanide nickel and chromium plating facility and later as a non-cyanide zinc plating facility. All contaminants associated with these types of operation were included as well as possible PAHs from machinery. Chromium, cadmium, nickel, and Benzo(a)anthracene were used as the main contaminants for HRS scoring purposes.

Groundwater Migration Pathway

There are no (0) groundwater, public water system wells, or public water intakes in the 4 mile site radius. There is one (1) non-active agricultural spring within 4 miles of the site. KDWM has no analytical data for groundwater at the site. Only the shallow groundwater aquifer was considered when scoring the site.

Surface Water Pathway

There are no drinking water intakes along the 15 mile TDL. All 30 miles of potential wetlands in the TDL are wetlands. However 29.86 miles of these wetlands are classified as Riverine, which is not an HRS sensitive Wetland. The remaining 0.14 miles of wetlands are classified as Freshwater Forested Wetlands, which is considered as an HRS sensitive wetland. However, this sensitive feature is found near the terminus of the TDL and the likelihood that contaminants from the site would have reached this small wetland is low. Any contaminants present in soil would be unlikely to migrate far off-site because of the distance they would need to travel in the railroad ditch to enter either of the two PPEs. The overall score this generated in the Environmental Component was low.

Soil Exposure Pathway

No residences, schools or daycares were identified within 200 feet of the site. A total of 2,369 people live within one mile of the site. A small number of workers, less than ten (10) are possible on the site. The site is fenced and gated. Trespassers are possible, but not probable due to the surrounding businesses. The only soil data is incomplete and dates to 1983. The 1983 data does not indicate any metals or other contaminants above current MCLs in the soil.

Summary

This scenario does not support further investigation under CERCLA.

****** CONFIDENTIAL ******
******PRE-DECISIONAL DOCUMENT ******
****** SUMMARY SCORESHEET ******
****** FOR COMPUTING PROJECTED HRS SCORE ******

****** Do Not Cite or Quote ******

Site Name: Shelby Industries | Region: Region 4

Scenario Name: Worst Case

City, County, State: Shelbyville/Shelby, Kentucky | Evaluator: Daniel Phelps, PG

EPA ID#: | Date: 05/15/2017

Lat/Long: 38:12:18,-85:15:28

Congressional District: 4th

This Scoresheet is for: Pre-CERCLA Screening

Scenario Name: Worst Case

Description:

	S pathway	S^2 pathway
Ground Water Migration Pathway Score (S_{gw})	3.52	12.39
Surface Water Migration Pathway Score (S_{sw})	1.97	3.88
Soil Exposure Pathway Score (S_s)	0.25	0.06
Air Migration Score (S_a)	0.0	0.0
$S^2_{gw} + S^2_{sw} + S^2_s + S^2_a$		16.33
$(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a)/4$		4.08
/ $(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a)/4$		2.02

Pathways not assigned a score (explain):

TABLE 3-1 --GROUND WATER MIGRATION PATHWAY SCORESHEET			
Factor categories and factors	Maximum Value	Value Assigned	
Aquifer Evaluated: Shallow Groundwater			
Likelihood of Release to an Aquifer:			
1. Observed Release	550	550.0	
2. Potential to Release:			
2a. Containment	10	10.0	
2b. Net Precipitation	10	10.0	
2c. Depth to Aquifer	5	5.0	
2d. Travel Time	35	35.0	
2e. Potential to Release [lines 2a(2b + 2c + 2d)]	500	500.0	
3. Likelihood of Release (higher of lines 1 and 2e)	550		550.0
Waste Characteristics:			
4. Toxicity/Mobility	(a)	10000.0	
5. Hazardous Waste Quantity	(a)	10.0	
6. Waste Characteristics	100		18.0
Targets:			
7. Nearest Well	(b)	0.0	
8. Population:			
8a. Level I Concentrations	(b)	0.0	
8b. Level II Concentrations	(b)	0.0	
8c. Potential Contamination	(b)	29.4	
8d. Population (lines 8a + 8b + 8c)	(b)	29.4	
9. Resources	5	0.0	
10. Wellhead Protection Area	20	0.0	
11. Targets (lines 7 + 8d + 9 + 10)	(b)		29.4
Ground Water Migration Score for an Aquifer:			
12. Aquifer Score [(lines 3 x 6 x 11)/82,5000][c]	100		3.52
Ground Water Migration Pathway Score:			
13. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated)[c]	100		3.52

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer

Table 4-1 --Surface Water Overland/Flood Migration Component Scoresheet			
Factor categories and factors	Maximum Value	Value Assigned	
Watershed Evaluated: Surface water/overland			
Drinking Water Threat			
Likelihood of Release:			
1. Observed Release	550	550.0	
2. Potential to Release by Overland Flow:			
2a. Containment	10	10.0	
2b. Runoff	10	1.0	
2c. Distance to Surface Water	5	16.0	
2d. Potential to Release by Overland Flow [lines 2a(2b + 2c)]	35	170.0	
3.Potential to Release by Flood:			
3a. Containment (Flood)	10	10.0	
3b. Flood Frequency	50	0.0	
3c. Potential to Release by Flood (lines 3a x 3b)	500	0.0	
4. Potential to Release (lines 2d + 3c, subject to a maximum of 500)	500	170.0	
5. Likelihood of Release (higher of lines 1 and 4)	550		550.0
Waste Characteristics:			
6. Toxicity/Persistence	(a)	10000.0	
7. Hazardous Waste Quantity	(a)	10.0	
8. Waste Characteristics	100		18.0
Targets:			
9. Nearest Intake	50	0.0	
10. Population:			
10a. Level I Concentrations	(b)	0.0	
10b. Level II Concentrations	(b)	0.0	
10c. Potential Contamination	(b)	16.3	
10d. Population (lines 10a + 10b + 10c)	(b)	16.3	
11. Resources	5	0.0	
12. Targets (lines 9 + 10d + 11)	(b)		16.3
Drinking Water Threat Score:			
13. Drinking Water Threat Score [(lines 5x8x12)/82,500, subject to a max of 100]	100		1.95
Human Food Chain Threat			
Likelihood of Release:			
14. Likelihood of Release (same value as line 5)	550		550.0
Waste Characteristics:			
15. Toxicity/Persistence/Bioaccumulation	(a)	5.0E8	
16. Hazardous Waste Quantity	(a)	10.0	
17. Waste Characteristics	1000		180.0
Targets:			
18. Food Chain Individual	50	0.0	
19. Population			
19a. Level I Concentration	(b)	0.0	
19b. Level II Concentration	(b)	0.0	
19c. Potential Human Food Chain Contamination	(b)	0.01	
19d. Population (lines 19a + 19b + 19c)	(b)	0.01	
20. Targets (lines 18 + 19d)	(b)		0.01
Human Food Chain Threat Score:			
21. Human Food Chain Threat Score [(lines 14x17x20)/82500, subject to max of 100]	100		0.01
Environmental Threat			
Likelihood of Release:			
22. Likelihood of Release (same value as line 5)	550		550.0
Waste Characteristics:			
23. Ecosystem Toxicity/Persistence/Bioaccumulation	(a)	5.0E8	
24. Hazardous Waste Quantity	(a)	10.0	
25. Waste Characteristics	1000		180.0

Targets:			
26. Sensitive Environments			
26a. Level I Concentrations	(b)	0.0	
26b. Level II Concentrations	(b)	0.0	
26c. Potential Contamination	(b)	0.01	
26d. Sensitive Environments (lines 26a + 26b + 26c)	(b)	0.01	
27. Targets (value from line 26d)	(b)		0.01
Environmental Threat Score:			
28. Environmental Threat Score [(lines 22x25x27)/82,500 subject to a max of 60]	60		0.01
Surface Water Overland/Flood Migration Component Score for a Watershed			
29. Watershed Score[c] (lines 13+21+28, subject to a max of 100}	100		1.97
Surface Water Overland/Flood Migration Component Score			
30. Component Score (S_{sw})[c] (highest score from line 29 for all watersheds evaluated)	100		1.97

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer

TABLE 4-25 --GROUND WATER TO SURFACE WATER MIGRATION COMPONENT SCORESHEET			
Factor categories and factors	Maximum Value	Value Assigned	
Watershed Evaluated: Surface water/overland			
Drinking Water Threat			
Likelihood of Release to an Aquifer:			
1. Observed Release	550	550.0	
2. Potential to Release:			
2a. Containment	10	10.0	
2b. Net Precipitation	10	10.0	
2c. Depth to Aquifer	5	5.0	
2d. Travel Time	35	15.0	
2e. Potential to Release [lines 2a(2b + 2c + 2d)]	500	300.0	
3. Likelihood of Release (higher of lines 1 and 2e)	550		550.0
Waste Characteristics:			
4. Toxicity/Mobility	(a)	10000.0	
5. Hazardous Waste Quantity	(a)	10.0	
6. Waste Characteristics	100		18.0
Targets:			
7. Nearest Well	(b)	0.0	
8. Population:			
8a. Level I Concentrations	(b)	0.0	
8b. Level II Concentrations	(b)	0.0	
8c. Potential Contamination	(b)	0.0	
8d. Population (lines 8a + 8b + 8c)	(b)	0.0	
9. Resources	5	0.0	
10. Targets (lines 7 + 8d + 9)	(b)		0.0
Drinking Water Threat Score:			
11. Drinking Water Threat Score ([lines 3 x 6 x 10]/82,500, subject to max of 100)	100		0.0
Human Food Chain Threat			
Likelihood of Release:			
12. Likelihood of Release (same value as line 3)	550	550.0	
Waste Characteristics:			
13. Toxicity/Mobility/Persistence/Bioaccumulation	(a)	5.0E8	
14. Hazardous Waste Quantity	(a)	10.0	
15. Waste Characteristics	1000		180.0
Targets:			
16. Food Chain Individual	50	0.0	
17. Population			
17a. Level I Concentration	(b)	0.0	
17b. Level II Concentration	(b)	0.0	
17c. Potential Human Food Chain Contamination	(b)	0.01	
17d. Population (lines 17a + 17b + 17c)	(b)	0.01	
18. Targets (lines 16 + 17d)	(b)		0.01
Human Food Chain Threat Score:			
19. Human Food Chain Threat Score [(lines 12x15x18)/82,500,suject to max of 100]	100		0.01
Environmental Threat			
Likelihood of Release:			
20. Likelihood of Release (same value as line 3)	550		550.0
Waste Characteristics:			
21. Ecosystem Toxicity/Persistence/Bioaccumulation	(a)	0.0	
22. Hazardous Waste Quantity	(a)	10.0	
23. Waste Characteristics	1000		0.0
Targets:			
24. Sensitive Environments			
24a. Level I Concentrations	(b)	0.0	
24b. Level II Concentrations	(b)	0.0	

24c. Potential Contamination	(b)	0.0	
24d. Sensitive Environments (lines 24a + 24b + 24c)	(b)	0.0	
25. Targets (value from line 24d)	(b)		0.0
Environmental Threat Score:			
26. Environmental Threat Score [(lines 20x23x25)/82,500 subject to a max of 60]	60		0.0
Ground Water to Surface Water Migration Component Score for a Watershed			
27. Watershed Score[c] (lines 11 + 19 + 28, subject to a max of 100)	100		0.01
28. Component Score (S_{gs})[c] (highest score from line 27 for all watersheds evaluated, subject to a max of 100)	100		0.01

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer

TABLE 5-1 --SOIL EXPOSURE PATHWAY SCORESHEET			
Factor categories and factors	Maximum Value	Value Assigned	
Likelihood of Exposure:			
1. Likelihood of Exposure	550		
Waste Characteristics:			
2. Toxicity	(a)	10000.0	
3. Hazardous Waste Quantity	(a)	10.0	
4. Waste Characteristics	100		18.0
Targets:			
5. Resident Individual	50		
6. Resident Population:			
6a. Level I Concentrations	(b)	0	
6b. Level II Concentrations	(b)		
6c. Population (lines 6a + 6b)	(b)		
7. Workers	15	5.0	
8. Resources	5		
9. Terrestrial Sensitive Environments	(c)	50.0	
10. Targets (lines 5 + 6c + 7 + 8 + 9)	(b)		55.0
Resident Population Threat Score			
11. Resident Population Threat Score (lines 1 x 4 x 10)	(b)		0.0
Nearby Population Threat			
Likelihood of Exposure:			
12. Attractiveness/Accessibility	100	5.0	
13. Area of Contamination	100	60.0	
14. Likelihood of Exposure	500		5.0
Waste Characteristics:			
15. Toxicity	(a)	10000.0	
16. Hazardous Waste Quantity	(a)	10.0	
17. Waste Characteristics	100		18.0
Targets:			
18. Nearby Individual	1	1.0	
19. Population Within 1 Mile	(b)	236.9	
20. Targets (lines 18 + 19)	(b)		237.9
Nearby Population Threat Score			
21. Nearby Population Threat (lines 14 x 17 x 20)	(b)		21411.0
Soil Exposure Pathway Score:			
22. Pathway Score[d] (S_s), [lines (11+21)/82,500, subject to max of 100]	100		0.25

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] No specific maximum value applies to factor. However, pathway score based solely on terrestrial sensitive environments is limited to a maximum of 60
[d] Do not round to nearest integer

TABLE 6-1 --AIR MIGRATION PATHWAY SCORESHEET		
Factor categories and factors	Maximum Value	Value Assigned
Likelihood of Release:		
1. Observed Release	550	
2. Potential to Release:		
2a. Gas Potential to Release	500	
2b. Particulate Potential to Release	500	
2c. Potential to Release (higher of lines 2a and 2b)	500	
3. Likelihood of Release (higher of lines 1 and 2c)	550	
Waste Characteristics:		
4. Toxicity/Mobility	(a)	
5. Hazardous Waste Quantity	(a)	
6. Waste Characteristics	100	
Targets:		
7. Nearest Individual	50	
8. Population:		
8a. Level I Concentrations	(b)	
8b. Level II Concentrations	(b)	
8c. Potential Contamination	(c)	
8d. Population (lines 8a + 8b + 8c)	(b)	
9. Resources	5	
10. Sensitive Environments:		
10a. Actual Contamination	(c)	
10b. Potential Contamination	(c)	
10c. Sensitive Environments (lines 10a + 10b)	(c)	
11. Targets (lines 7 + 8d + 9 + 10c)	(b)	
Air Migration Pathway Score:		
12. Pathway Score (S_a) [(lines 3 x 6 x 11)/82,500][d]	100	

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] No specific maximum value applies to factor. However, pathway score based solely on sensitive environments is limited to a maximum of 60.
[d] Do not round to nearest integer

Attachment A: Pre-CERCLA Screening Checklist/Decision Form

This form is used in conjunction with a site map and any additional information required by the EPA Region to document completion of a Pre-CERCLA Screening (PCS). The form includes a decision on whether a site should be added to the Superfund program's active site inventory for further investigation. Select from available dropdown values for fields marked with an asterisk *.

Region: 4 State/Territory: KY Tribe: ____________ ____________

Click here for the EPA Tribe Entity Mapping spreadsheet. **EPA ID No. (If Available)**

Site Name: Shelby Industries

Other Site Name(s):

Site Location: 175 McDaniels Road
(Street)

4 Shelbyville Shelby KY 40065 +

Congressional District (City) (County) (State / Terr) (Zip+4)

If no street address is available ____________ (Township-Range) ____________ (Section)

Checklist Preparer:

Daniel Phelps, Geologist Registered (Name / Title) — 08/23/2017 (Date)

Division of Waste Management, Superfund Branch (Organization) — (502) 782-6733 (Phone)

300 Sower Boulevard, 2nd Floor (Street) — daniel.phelps@ky.gov (Email)

Frankfort (City) — Franklin (County) — KY (State / Terr) — 40601 + (Zip+4)

Site Contact Info/Mailing Address: 175 McDaniel Road
Shelbyville KY 40065

CERCLA 105d Petition for Preliminary Assessment? No — If Yes, Petition Date (mm/dd/yyyy): ____________

RCRA Subtitle C Site Status: Is site in RCRAInfo? No — If Yes, RCRAInfo Handler ID #: ____________

Ownership Type*: Private — Additional RCRAInfo ID #(s): 0020427111

Site Type*: Manufacturing/Processing/Maintenance — State ID #(s): AI# 39894

Site Sub-Type*: Metal fabrication/finishing/coating & allied industries — Other ID #(s): ____________

Federal Facility? No — Federal Facility Owner*: (Make selection)

Formerly Used Defense Site (FUDS)? No — Federal Facility Operator*: (Make selection)

Federal Facility Docket? No — If Yes, FF Docket Listing Date (mm/dd/yyyy): ____________

Federal Facility Docket Reporting Mechanism*: (Make selection)

Native American Interest? No — If Yes, list Tribe: ____________

Additional Tribe (s): ____________

Attachment A: Pre-CERCLA Screening Checklist/Decision Form

Site Description

Use this section to briefly describe site background and conditions if known or (easily) available, such as: operational history; physical setting and land use; site surface description, soils, geology and hydrogeology; source and waste characteristics; hazardous substances/contaminants of concern; historical releases, previous investigations and cleanup activities; previous regulatory actions, including permitting and enforcement actions; institutional controls; and community interest.

Insert text here

See Narrative Report dated August 2017.

Geospatial Information

Latitude: + 38.205004
Decimal Degree North (e.g., +38.859156)

Longitude: - 85.257725
Decimal Degree West (e.g., -77.036783)

Provide 4 significant digits at a minimum, more if your collection method generates them.

Except for certain territories in the Pacific Ocean, all sites in U.S. states and territories are located within the northern and western hemispheres and will have a positive latitude sign and negative longitude sign. The coordinate signs should be changed as necessary for sites in the southern and/or eastern hemispheres.

Point Description: Select the option below that best represents the site point for future reference and to distinguish it from any nearby sites.

- ☐ Geocoded (address-matched) Site Address
- ☒ Site Entrance (approximate center of curb-cut)
- ☐ Approximate Center of Site
- ☐ Other Distinguishing Site Feature (briefly describe below):

Point Collection Method: Check the method used to collect the coordinates above and enter the date of collection.

- ☒ Online Map Interpolation
- ☐ GPS (handheld, smartphone, other device or technology with accuracy range < 25 meters)
- ☐ GPS Other (accuracy range is ≥ 25 meters or unspecified)
- ☐ Address Matching: Urban
- ☐ Address Matching: Rural
- ☐ Other Method: ______

Collection Date (mm/dd/yyyy): 04/06/2017

POINT-SELECTION CONSIDERATIONS

- Often the best point is a feature associated with the environmental release or that identifies the site visually.
- Use the curb cut of the entrance to the site if there is a clear primary entrance and it is a good identifier for the overall location.
- The approximate center of the site (a guess at the centroid) is useful for large-area sites or where there are no appropriate distinguishing features.
- Use the geocoded address if that is the only or best option available, but if possible use something more representative for sites larger than 50 acres.

Attachment A: Pre-CERCLA Screening Checklist/Decision Form

Complete this checklist to help determine if a site should be added to the Superfund Active site inventory. See Section 3.6 of the PCS guidance for additional information.	YES	NO	Unknown
1. An initial search for the site in EPA's Superfund active, archive and non-site inventories should be performed prior to starting a PCS. Is this a new site that does not already exist in these site inventories?	☒	☐	☐
2. Is there evidence of an actual release or a potential to release?	☒	☐	☐
3. Are there possible targets that could be impacted by a release of contamination at the site?	☒	☐	☐
4. Is there documentation indicating that a target has been exposed to a hazardous substance released from the site?	☐	☐	☒
5. Is the release of a naturally occurring substance in its unaltered form, or is it altered solely through naturally occurring processes or phenomena, from a location where it is naturally found?	☐	☒	☐
6. Is the release from products which are part of the structure of, and result in exposure within, residential buildings or business or community structures?	☐	☒	☐
7. If there has been a release into a public or private drinking water supply, is it due to deterioration of the system through ordinary use?	☐	☒	☐
8. Are the hazardous substances possibly released at the site, or is the release itself, excluded from being addressed under CERCLA?	☐	☒	☐
9. Is the site being addressed under RCRA corrective action or by the Nuclear Regulatory Commission?	☐	☒	☐
10. Is another federal, state, tribe or local government environmental cleanup program other than site assessment actively involved with the site (e.g., state voluntary cleanup program)?	☒	☐	☐
11. Is there sufficient documentation or evidence that demonstrates there is no likelihood of a significant release that could cause adverse environmental or human health impacts?	☐	☒	☐
12. Are there other site-specific situations or factors that warrant further CERCLA remedial/integrated assessment or response?	☒	☐	☐

Attachment A: Pre-CERCLA Screening Checklist/Decision Form

Preparer's Recommendation: ☒ Add site to the Superfund active site inventory.

☐ Do not add site to the Superfund active site inventory.

Please explain recommendation below:

PCS Summary and Decision Rationale

Use this section to summarize PCS findings and support the decision to add or not add the site to the Superfund active site inventory for further investigation. Information does not need to be specific but, where known, can include key factors such as source and waste characteristics (e.g., drums, contaminated soil); evidence of release or potential release; threatened targets (e.g., drinking water wells); key sampling results (if available); CERCLA eligibility; involvement of other cleanup programs; and other supporting factors.

Insert text here

See Narrative Report dated August 2017.

Site Assessor: Daniel Phelps, PG Daniel Phelps 08/23/2017

Print Name/Signature Date

EPA Regional Review and Pre-CERCLA Screening Decision

Add site to the Superfund active site inventory for completion of a:

☐ Standard/full preliminary assessment (PA)
☐ Abbreviated preliminary assessment (APA)
☐ Combined preliminary assessment/site inspection (PA/SI)
☐ Integrated removal assessment and preliminary assessment
☐ Integrated removal assessment and combined PA/SI
☒ Other: Investigate by KY Superfund, State Section

Do not add site to the Superfund active site inventory. Site is:

☐ Not a valid site or incident
☐ Being addressed by EPA's removal program
☐ Being addressed by a state cleanup program
☐ Being addressed by a tribal cleanup program
☐ Being addressed under the Resource Conservation and Recovery Act
☐ Being addressed by the Nuclear Regulatory Commission
☐ Other: ______

EPA Regional Reviewer: DONNA SEADLER Digitally signed by DONNA SEADLER Date: 2017.12.20 11:13:42 -05'00'

Print Name/Signature Date

Site Description

(All text as entered on page 2)

See Narrative Report dated August 2017.

PCS Summary and Decision Rationale

(All text as entered on page 4)

See Narrative Report dated August 2017.